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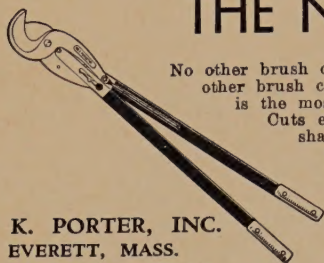


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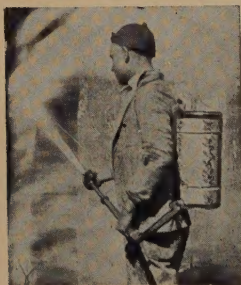
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CONTENTS



Editorial: Forestry and the Lumber Tariff	95
The Correlation of Forestry and Wildlife Management	98
IRA N. GABRIELSON	
Forestry and Game Management	104
HERMAN H. CHAPMAN	
Western Forestry and Conservation Association Annual Meeting	107
Forestry on the Whitney Preserve in the Adirondacks	111
A. B. RECKNAGEL	
Forest School Statistics for 1935: Degrees Granted, and Enrollments	114
CEDRIC H. GUISE	
Some Financial Aspects of Silviculture and Emergency Relief	121
E. B. MOORE AND A. T. COTTRELL	
The European Spruce Sawfly in the United States	125
H. J. MACALONEY	
Federal, State, and Private Cooperation in a Forestry Program	130
FRED W. MORRELL	
Professional Honesty as Regards Selective Logging	136
RALPH C. HAWLEY	
Painted Numbers on Trees in Permanent Sample Plots	139
ROBERT T. CLAPP	
A Paint Spray Outfit for Numbering Trees	141
RALPH C. HALL	
The Effect of Steaming on the Durability of Unseasoned Sap-Gum Lumber	147
T. C. SCHEFFER AND R. M. LINDGREN	
Changes Resulting from Thinning in Young Pine Plantations	154
W. R. ADAMS	
Effects of Varying Densities of Hardwood Cover on Growth and Survival of Shortleaf Pine Reproduction	166
W. R. BECTON	
A Comparison of Several Methods of Making Moisture Determinations of Standing Trees and Logs	169
B. J. HUCKENPAHLER	
Investigations of Nectria Diseases in Hardwoods of New England	169
PERLEY SPAULDING, T. J. GRANT AND T. T. AYERS	
Briefer Articles and Notes	180
Novel Tool for Transplanting Wildings; A Rule of Thumb for Log Scaling; The St. Louis Meeting of the A.A.A.S.	
Reviews	188
The Design of Experiments; Improvement Cutting and Thinning as Applied to Central New England Hardwoods; Low Versus High Thinning.	
Correspondence	188

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EDITORIAL

FORESTRY AND THE LUMBER TARIFF

TEN months ago the JOURNAL OF FORESTRY editorially emphasized that foresters must think. In the field of public policy, it was declared, a responsibility rests on the profession to bring to bear its specialized knowledge, wherever this knowledge can help to disclose right courses of action. A plea was made for professional discussion of moot questions of public policy on a professional basis, freed from *parti pris* on extraneous grounds.

In 1930 the present Editor-in-Chief of the JOURNAL contributed an article on "A Public Forest Policy." In it under the subhead "Encouragement of Private Forest Management," he said in part: "Whether tariff protection against the competition of forest products imported from foreign countries is a feasible means of encouraging the practice of forestry in the United States, and is justified as in the public interest under present conditions, should also be given study."

Hitherto, public forest policy in the United States has almost entirely ignored the question. For this there has been no good reason. Tariff policies long constituted one of the major party issues. The lines were drawn, broadly speaking, between those who wished to encourage the building up of manufacturing industries by affording them the protection of a tariff wall and those who believed

that trade should be free to take its natural course with as little governmental interference and regulation as possible. Practically, however, the actual framing of schedules has too often been based less on broad considerations of national interest than on sectional interests, the pressure for economic advantage of special groups, industries, and enterprises, and on log-rolling and pull. The tariff has been so much of a political football that to be drawn into the argument would have been likely to prove politically embarrassing for forestry, if not dangerous, and futile from the standpoint of obtaining action sincerely designed to promote forestry.

It is improbable that foresters anywhere in the United States have gone deeply into the relationships between import duties on forest products and forest management. The guess may be hazarded that the thought of foresters on this subject stems not from forest economics but from their beliefs or viewpoints on general foreign trade or domestic industrial policies. It is doubtful if this somewhat ostrichlike professional attitude can be maintained. The question of the relationship between protection tariff rates and private forestry is being pressed on foresters. It came into view in connection with the recently concluded Canadian trade agreement. Perhaps it

was that agreement which led the President, G. F. Jewett, of the Western Forestry and Conservation Association, at its annual meeting in Portland in December, to include the final interrogation in the following paragraph of his opening address. Speaking directly to the Chief of the Forest Service, he said:

"Many social minded lumbermen would like to know to what degree you are willing to assume leadership to see that taxation on forests is reformed and that loans are made available to enterprises in need of them? Or how much influence you are willing to bring to bear upon the Administration to secure tariff protection to our forests from the competition of foreign countries which operate under a lower standard of living?"

The first thought of the man on the street is that by importing foreign lumber we reduce the drain on our own forests, and thereby promote conservation. An approaching exhaustion of our home timber through overcutting is the dominating popular conception. It has led to advocacy of shutting off lumber exports as well as advocacy of putting forest products on the free list. People who have not cared to inform themselves accurately sometimes assert that the timber famine idea was a bugaboo invented by forestry enthusiasts, with more or less villainous intent, in the first decade of the present century. On the contrary, history shows that it had become virtually an axiom in popular discussion of the country's forest problem many years earlier. A striking illustration was afforded when the tariff revision of 1883 was under way.

In 1872 the first specific duty had been imposed on lumber—\$2 per thousand on pine and \$1 on hemlock and other cheaper woods. Logs, on the other hand, were put on the free list. Michigan mills were beginning to import logs from Canada, and American lumbermen soon became heavy purchasers of stumpage in Ontario;

but lumber sawed in Canadian mills largely sought an export market in the United States. To protect its own industry Canada imposed, in 1881, a retaliatory export tax of \$1 per thousand on logs. This set the stage for a dramatic fight two years later.

For once, in preparation for a new tariff law an attempt was made in 1883 to frame the measure from the standpoint of broad policy and national welfare free from the political pull and haul of special and local interests. A tariff commission of nine members, not in political life, was appointed to study the whole problem and draft proposals. Only the lumber tariff is of concern here. The commission left the old duties unchanged and a storm of protest swiftly rose.

Pages could be filled with quotations from editorials in such newspapers as the *New York Times*, *Sun*, *World*, *Evening Post*, and *Daily Commercial Bulletin*, the *Boston Daily Advertiser*, *Springfield Republican*, *Cincinnati Commercial Gazette*, *Chicago Tribune*, and *Kansas City Times*. Two major points were driven home: that the country's timber supply was nearing exhaustion, and that a lumber tariff was in essence a bounty to stimulate cutting and swell the profits of an already monopolistic industry able to dictate prices and enriched by mounting stumpage values. With regard to this last it may be noted in passing that, according to the reports of the Board of Trade of Saginaw, stumpage values in Michigan increased sixfold between 1866 and 1883—and this despite the deflationary effect on general prices of the shift from greenback currency to a gold basis, accomplished through the resumption of specie payments in 1879.

The *New York Evening Post* asked: "Can the American people afford to sacrifice an essential condition of the future prosperity of the country to the destructive greed of a few lumbermen?" And three days later: Removal of the duty

as something more than a question of free trade or protection, and its importance was not to be measured by the advantages of cheap lumber to the consumer, important as this is, nor by the effects on the manufacturer. "It means protection or destruction of the forests, and the destruction of the forests means great national calamity . . . The future prosperity of the country is at stake!"

This was the conservation viewpoint of fifty years ago and more. It was wildly wrong in many particulars. But one point at least was clearly seen—that a duty on lumber tends to harden the market and increase the value of stumpage. The prevailing thought among foresters in recent years has been that market instability and too low lumber prices are a serious obstacle to private timber growing, and that better stumpage prices will in the long run be in the public interest. While increased stumpage values will improve the position of the speculative holder, they will also increase the possible earnings from forest management and tend to raise the value of land devoted to forest management.

Whether, all things considered, the tariff should be used as an instrument of public policy to promote conservation is an undetermined question. It may, if the attempt is made so to use it without thoroughgoing study of the probable consequences, work in unanticipated ways. In the judgment of the present writer, if it is to be so used it should be only as a coordinated part of a comprehensive general plan of public action on behalf of

forestry. Under the methods of tariff legislation of the past, to look for its consideration by Congress on any such basis would be wholly Utopian. The world situation with respect to international commerce, however, bids fair to compel new viewpoints on the tariff, and a more nationalistic foreign trade control. And there again, other elements than merely forest conservation become involved.

The press has carried recently a letter written to the Secretary of State by Wilson Compton on behalf of the lumber industry, which to the present writer seems statesmanlike in its breadth of view. Space unfortunately permits here only brief quotation from it; it deserves to be read in full and pondered by all foresters:

"It is important that the opportunity, under the government, to secure a general restoration of international commerce be not needlessly impeded or impaired. . . The lumber industry has frankly criticized the agreement with Canada. May it, with equal frankness, state that it recognizes and respects the agreement as constituting the deliberate conclusion of the President. . . It expresses the hope that the government will, in so far and in such ways as it can, aid the industry to meet this further difficulty now added to its already difficult situation."

That the lumber industry needs and should have due public aid in carrying out its forest conservation objectives is widely recognized. In the country's foreign trade policy lies part of the field within which a fully comprehensive national conservation policy remains to be formulated.

THE CORRELATION OF FORESTRY AND WILDLIFE MANAGEMENT

By IRA N. GABRIELSON

Chief of the Bureau of Biological Survey

IN attempting a brief discussion of the correlation of forestry and wildlife management, which can touch only a few of the more important factors, temporarily ignoring exceptions, may I emphasize that the discussion is in no way critical of foresters or forestry practices, but merely attempts to indicate a few points at which it seems possible to correlate the two functions for the greater good of wildlife.

Can forestry and wildlife management be correlated into an economically feasible program? It is certainly possible. How then can it be started? Several steps which can contribute to this end suggest themselves as worthy of consideration.

1. Some additions to the curriculum of the average forestry school.

2. Comparatively slight modifications of present forestry management practices to correlate them with the needs of wildlife.

3. Similar modifications in the viewpoint of and practices advocated by biologists and conservationists.

It has been my privilege to know intimately many foresters and visit many forests during the past twenty years. The average forester is well trained in his profession when he leaves school. He knows thoroughly the technical side of surveying, timber cruising, trail building, and the multitude of other activities which make up the routine of his profession, but comparatively few of them clearly conceive of a forest as an interrelated community of living organisms. This is no particular fault of theirs, as until recently few forestry schools have included

anything more than very inadequate courses in biology and ecology in their curricula. During the last few years several schools have started courses under the general term of Game Management or Wildlife Management, but not many of them have been operating long enough to graduate students with a biological background.

This development is still too new to affect very greatly the rank and file of forest personnel, but from the standpoint of wildlife it is a very encouraging program.

In discussing the second point, the concerning reasonable modification of present forestry practices, mention must be made of two important ideas which have been given increasing attention in recent years by the federal Forest Service. Each one can be used constructively to aid the wildlife population of forest lands. These two are the idea of multiple use of forest lands, and the management of forests on a sustained yield basis.

The concept of multiple use has been growing slowly for years, encouraged partly, at least, by the increasing thousands of people who are using the forests for recreational purposes. This evolutionary development has encouraged those who could see in a forest something more than an area where it was possible to grow so many thousand board feet to the acre. Inevitably there will be conflict of interests and ideas in the evolution of this program. Livestock men having grazing permits on western forests are especially apprehensive that increasing recreational use will limit the grazing allowance on these areas. This may be true to

certain extent, though no one can project long time trends with complete confidence. In the end the highest and most profitable use of the lands will undoubtedly govern, and in many cases this undoubtedly means correlation of several uses rather than exclusive privileges held out and fostered for the benefit of any one group or interest. Under such a program wildlife will undoubtedly receive increasing consideration.

The program of management which calls for the harvesting of the forests on a sustained yield basis, which is the present policy on National as well as many State Forests, will with some modification operate to provide automatically a better environment for wildlife than now prevails on much of the timbered area.

To amplify this statement and show the value of a slight modification of the present program it is necessary to consider the needs of forest animals and birds.

Briefly, it may be said that the great majority of such species, particularly those regarded as game, are most abundant along the line where two different vegetative types meet. This fact is being recognized and given its proper significance by an increasing number of authorities in recent years.

Every hunter has long utilized the fact that in forest glades, along the trails, or on the edges of brush patches, he had his greatest chance of success, but few have appreciated its significance in a wildlife management plan.

In eastern hardwood forests and the heavy spruce, fir, or redwood forests of the west coast this fact is less obscured by other factors than in the yellow-pine forests of the Rockies or the open long-leaved pine forests of the south. In the first two types the wildlife is obviously concentrated along the trails and roads, the natural glades and openings, or about cut-over or burned-over areas. Here,

where the forest canopy is broken, they find the greatest variety of vegetation to provide seeds, fruits, nuts, herbage, or browse. In addition they find more abundant and more varied cover than in the gloomy depths of the solid forests, where one may walk for miles without seeing a living thing.

In these mature forests where the canopy is complete, both food and cover are at a minimum and only those species may be found that are specially adapted to live in or on the dominant forest trees. Tree squirrels, chipmunks, woodpeckers, kinglets, chickadees, and similar forms are found most frequently, although even these are often more abundant near the edges of these solid forests than in their centers.

The same thing is true to a slightly less extent in the mixed hardwoods of the eastern states, though here the number of birds and animals found in the forest depths is somewhat greater, due to the greater diversity of trees which make up the stand.

For the sake of better illustrating the point, a cutting cycle on a given working circle handled on a sustained yield basis may be assumed to be 80 years. If this program should be followed, the area which has been cut-over 20 years or less will be about 25 per cent of the total. This 25 per cent will furnish suitable environment (other things being equal) and favorable shelter and food conditions for most of the wildlife, particularly game species, to be found on the total unit, and the wildlife distribution over the entire area will be roughly governed by the distribution of this age class. Obviously, the more widely distributed these newly cut-over lands can be, the more uniform will be the distribution of wildlife and the more fully it will be able to utilize such food and cover resources as are available in the less favorable age classes.

In estimating carrying capacity for

wildlife the percentage of the forest in this class and its distribution are all important. For example, a 100,000-acre unit might be rated not on the basis of 100,000 acres of forest but rather on the 25,000 acres of 1 to 20 year old forest which furnishes the real game habitat. The smaller amount of cover in the older age classes between 20 and 80 might well be considered as a reserve for utilization under extraordinary conditions, and carrying capacities calculated on the capacity of the main game range.

From this standpoint the 1,250 acres to be cut over in a given year would be of much greater value if distributed as 25 50-acre cuttings than one operation of 1,250. If such a program could be followed for 20 years, the result would be the building of a permanent maximum carrying capacity by distributing the valuable age classes throughout the entire 100,000 acres. Naturally there would be other complicating factors, which are being ignored in order to demonstrate clearly the basic importance of such a program.

Logging engineers and foresters will immediately raise the point that logging in 50-acre units is uneconomical and therefore impossible. The forestry management plan must of necessity consider this point, and if game management is to be a part of forestry the *annual cut-over areas should be distributed in as small units as is economically possible* considering the type of timber present and methods of logging employed. The growing use of truck-logging methods makes such a scheme more feasible than formerly, especially in second-growth forests. Large blocks of cut-over land, while valuable for wildlife, do not have as great a value as smaller units which produce more miles of forest edges. In addition there is a chance of over-producing some certain species where conditions particularly favor it. The deer herd on the Allegheny

Forest seems to be a very good example of a combination of good law enforcement and exceptionally favorable food and cover conditions over a large block of land. Now that the forest is growing into a more advanced and unfavorable age class, an acute deer problem is created; despite a heavy hunting pressure the game population remains above the constantly diminishing carrying capacity of the forest and creates a difficult management problem.

Another modification which might well be considered is a moderation of the planting program, especially in the eastern United States, where concentrated human population will probably demand increasing recreational use. Many of the present planting programs call for complete utilization of all Site 1 and Site 2 lands for coniferous plantings. Much land so classified consists of natural glades along or near water courses which are of importance to many forms of wildlife. If carried to its ultimate possible goal the present program may eliminate all of the open glades and forest edge vegetation which is of such value to many of the best species of wildlife.

With an ever increasing acreage reverting to forest types in the eastern half of the country and a constantly expanding use of wood substitutes—which is already causing concern to timberland owners—there is a growing possibility that by the time this timber reaches harvesting size it will face a glutted market. Forest planting is not only a doubtful long-time venture for private landowners, but the advisability of huge and all-inclusive planting operations by public agencies might well be questioned.

On the other hand, not in many years have the game stocks exceeded the demand except in remote sections or in spots where legal obstacles prevented the full utilization of the supply. With a growing population and an increasing number

ber of hunters, there seems little likelihood that it ever will. Under such conditions a restriction of a planting program which conceivably could cover every glade and other opening vital to the maintenance of game population might well be considered.

Comparatively small plantings of conifers are invaluable as game cover—large blocks are not so used except about the edges. They operate to reduce the food supply by restricting the variety and abundance of food-bearing plants.

A third modification of forest practice that might be suggested is in the timber stand improvement program, which has been greatly enlarged in the eastern States by the development of C.C.C. camps and other forms of emergency labor which must be kept busy.

In the more recent work there is comparatively little to criticize, although in isolated spots operations still leave an adverse effect on wildlife. Such effects are more frequently noticed on State-owned Forests than on National Forests, due to the fact that State Forests are smaller and more intensive work is necessary in order to keep the men employed in a season when there is often little choice of activity.

The entire philosophy of timber stand improvement, with its emphasis on the removal of "weed trees," may be, and by some conservationists is, considered as inimical to wildlife. If it were possible to put it into full operation, our forests might eventually be devoid of all fruit and nut-bearing trees and shrubs, and would consist solely of the two or three species which in the judgment of present administrative officers will have the highest timber value in the coming years.

There is some theoretical but little actual chance of this occurring, as such a program does not seem economically feasible under present practices of timber utilization, although there are spots

in which it may approach maximum realization. Therefore the present danger to wildlife values is very much less than is feared by many individuals who are sincerely interested in wildlife.

In recent months areas have been seen where all beech has been girdled and felled to release other more "valuable trees" which, in one area, were nonexistent. On one tract all black cherry had been similarly treated, due to a misunderstanding on the part of the foreman, while on other sites dogwood, hickory, hawthorn, viburnum, wild crab, wild grape, and other valuable wildlife food plants have been destroyed.

On a few areas forest clean-up and timber stand improvement combined have resulted in complete destruction of both food and cover for wildlife. Such areas are small, and serve chiefly to demonstrate the necessity of careful definition of what is to be done before starting the work.

There is still another important factor. The forest land management agency should have either satisfactory working relationships with State game authorities or a direct voice in the handling of game species. If this is not provided for, it will not be possible to correlate wildlife populations with the carrying capacity of the land. It is already an acute problem in a number of widely scattered places, many of which are in the yellow pine forests of the west. Here a combination of good protection, adequate summer food and cover, and excessive utilization of winter ranges by game and livestock combined has created many serious situations. Even in this type of open forest, where the mature stands still carry a quantity of food plants, recognition of the transitory nature of good game land and development of utilization plans to provide a succession of cut-over lands in reasonably close proximity will eventually help, though not where snowfalls are

so heavy as to drive deer and elk, the species most usually involved, entirely out of the forests during the winter months.

Neither will such a program help in present emergencies, where a drastic reduction in either game or livestock or both is often the only practical solution to the problem.

I have endeavored to point out several possible modifications of forestry practice which will make a correlation of forestry and game management feasible. Conversely, there are modifications which may well be made in the practices advocated by wildlife conservationists before they can be successfully applied under present-day forestry conditions. This should include a recognition that forest lands cannot be managed exclusively or even chiefly for the benefit of wildlife, but rather that wildlife values must be improved in correlation with other use of such lands.

Planting of wildlife food and cover plants as a general proposition is of doubtful economic feasibility on publicly-owned forest lands. There are places where it can probably be justified, but the existing data do not point the way to its widespread use under present conditions. Such plantings should therefore be frankly experimental and limited in extent when done from the wildlife standpoint alone. Where erosion control by planting is necessary, consideration should be given to wildlife needs, and trees, shrubs, perennial plants, or grasses of value to wildlife utilized for this purpose. Herbaceous plants by introducing a new vegetative type may be especially desirable for wildlife, and at the same time serve admirably from an erosion control standpoint. Plant species of major importance for wildlife may also be encouraged on sites too poor to grow first-class timber. In other words, a timber stand improvement program which sacrifices timber trees on poor sites in favor of trees and shrubs having game

value may be as justifiable economically as the reserve program.

Actual planting solely for wildlife on public lands should be carefully studied before being attempted on a large scale.

The concept of large forest refuge areas where wildlife will always be unmolested and unanalyzed, seems attractive, but it is not in accord with biological probabilities nor with experience.

For example, the deplorable Kaibab deer situation resulted from a combination of favorable environment and entire protection of the animals for a term of years. The Yellowstone's elk problem and those of several other areas are essentially the same—as the herd increases automatically seals its doom by progressively destroying the available food plants.

These and many other examples are giving rise to a feeling that some modification of the refuge system is desirable. Such a modification should recognize the transitory nature of forest game ranges. It should take into account the fact that the earlier stages of forest growth provide the most favorable conditions, and that building up game stocks, particularly of deer and elk, to maximum carrying capacities during these favorable periods eventually will lead to destruction of available food supplies and ultimate starvation for many of the animals. Conservationists should frankly recognize this and realize that flexibility in the refuge idea so as to provide for utilization of surpluses is a requirement in the long time program.

Several schemes have been proposed. Smaller refuges from which the surplus animals naturally drift into areas open to hunting work well under some conditions. In others the periodic opening of refuges to hunting has been proposed under various sorts of regulations. Removal of a definite number of animals by the issuing of a limited number of

licenses has sometimes worked well, and may be a solution to the problem in dealing with some species. Still another alternative might be a movable refuge, or series of refuges, fitted into the growth cycle so that game population could be built up as food supplies increased and harvested as the forest commenced to deteriorate as game range.

The impulse of both biologists and foresters when game management in forest lands is discussed is to place emphasis on what is not known and to outline immediately a program of intensive research on the problems of the particular territory under discussion. As a research worker I would be the last to object to such a program. There are and always will be a great many problems requiring research—probably many more than the available money and man power can solve. Every effort should be made to find more and more facts. In response to this commendable urge many elaborate and imposing programs of research have been drawn up in recent years, but few of them have been put into effect. Those individuals who are working are finding the road to definite knowledge both rough and long, and this is to be expected in dealing with the complex interrelationships that exist between the living plants and animals that comprise the forest community.

In the meantime, must the ultimate acquirement of all this knowledge be attained before a management program is started? Is it not possible to apply existing knowledge and modify practices and programs as more knowledge becomes available?

It is my belief that the distribution of the younger age classes throughout the forest areas is one of the fundamentals of any correlation of forestry and wildlife management. Why not put it into effect, so far as it can be fitted into the forestry program, and let it be creating more

favorable wildlife environment while other problems are being worked out?

In this connection it might well be pointed out that no management plan, no matter how exhaustive the research on which it is based, can remain inflexible. Conditions are constantly changing, and these changes should be and can be utilized to the advantage of wildlife, even with existing knowledge.

In summarizing; it has been pointed out that on National Forests, which comprise the largest area of good and potentially good wildlife habitat under one administrative control, policies are already in effect which can with slight modification be correlated with a sound wildlife management program.

These modifications are:

1. Distribution of cutting operations each year over the working circles as uniformly and in as small units as is economically feasible.

2. Reconsider planting programs to determine if it is advisable in the face of probable heavy recreational demand to plant all glades and natural openings valuable for wildlife to solid stands of conifers (of little value to wildlife when in large blocks).

3. Re-define timber stand improvement concept in order to prevent any unnecessary damage to wildlife values. (This is more needed on State than National Forests.)

4. By some method give the land management agency a voice in management of game on lands under its administration.

5. Carefully scrutinize all programs for planting for wildlife to determine whether needed and economically feasible.

6. Study game refuges, particularly for big game animals, in the light of existing knowledge and new information constantly accumulating, and where necessary modify the refuge or refuge management to correspond with actual conditions.

FORESTRY AND GAME MANAGEMENT

BY HERMAN H. CHAPMAN

Yale School of Forestry

GAME management within forest areas looks to the production of the largest possible annual crops of game consistent with the preservation and management of the forest itself. It does not look upon game as the sole or even the primary product of the forest, but as one of several uses, including timber crops, watershed and soil protection, and on extensive areas in the West, the grazing of domestic stock. Game crops must find their proper place in this scheme, and it is the business of the forester to see that this resource, as well as others, is brought to its fullest utility.

Game management is just emerging from a prolonged period of domination by sportsmen interested only in the bag limits and hunting seasons on the one hand, and by politicians who battered on the enforcement of these primitive laws on the other; and now bids fair ultimately to take its place with forestry as a source of conservation and intelligently planned sustained yield, based on an understanding of the biological factors involved in maintaining such a balance, and a recognition by the public that only by giving entire control to men trained in these services can adequate results ever be achieved.

While the technical direction and control of game production in states and nation must rest with game specialists, the immediate problem, where definite areas of forest are concerned, is to secure full coordination in the specific management of these forests, so that neither the production of timber crops, nor the protection of watersheds, nor the grazing of livestock, nor the preservation of elk or deer becomes an exclusive aim, in the pursuit of

which all other values and interests are ignored.

The general position of the forester, in all civilized countries—a position accorded by the public as the best solution of their problem of adjustment of conflicting interests—gives him practically full control of all the different uses of a forest area. This solution is based on the belief that the forest crop is in fact the dominant use, giving the highest value per acre to society, and that other uses must therefore be subordinated and correlated to this use.

This solution, however, has not yet been accepted by the American public at large, and the nearest approach to it is in the proposal by the Department of Agriculture that the regulation of game on the National Forests be recognized as a federal responsibility and carried out by the Forest Service.

This theory is also based on a fundamentally important principle, namely, that the administration of any large body of land must be centered in one authority, on an area basis, and not divided between several different authorities on a functional basis. In the former case, the specialists appear as advisors and assistants, while in the latter they have the power to carry out any measure affecting their interest regardless of its effect on the whole administration or on other and perhaps more important interests.

Can foresters be trusted to administer game matters efficiently on forest areas under their charge? This would probably be answered in the negative by most of the game interests at present, in the belief, first, that foresters know too little about game, and second, that they sacrifice game values in an unintelligent manner, in order

to secure higher production of commercial trees.

What these game interests do not seem to realize is that the entire profession of forestry is based on the principle of co-ordinated use of all land resources, including agriculture, and not upon the exclusive pursuit of a hobby such as parks, or game, or a single interest like grazing or lumbering; that because of this fact foresters after admitting grazing to the National Forests were the first federal agency to control it in the public interest; that foresters were the first to detect and endeavor to control erosion resulting from destruction of vegetative cover on other than agricultural lands, and that following a natural path of development foresters were the first to establish modern scientific principles of game management, both abroad and in the United States.

It is natural and inevitable that as soon as a profession of trained game and fish specialists arose, their contributions to this science should swiftly outrank the empirical knowledge of foresters, whose special training had been in other fields, with the result that many definite and practical suggestions were made, by which game conditions could be greatly improved by modifying forestry practice. The significant point is that foresters, instead of resisting these ideas, have made immediate efforts to incorporate them in plans for forest management.

The important features of sound game management are, increase in the natural food supply for the game, natural or vegetative protection from climate and predators, opportunity to increase up to the limit of the carrying capacity of the range, and finally, the preservation of this natural balance between food, game, and predators. In this tension the entrance of man and his activities as a predator is the most important element, and the entire problem of predator control must be worked out on the basis, not of complete protection from all killing, but on

the *relative* amount of kill which is to be secured for sportsmen as against animal predators.

The most extreme and dangerous form of abnormal management occurs when all forms of predatory activity, including hunting, are prohibited successfully in the interest of the nature-loving public, who wish to see the wild animals in much the same manner but in far more elevating surroundings and conditions than are maintained in zoos. Where this natural but totally unscientific management is practiced, and the healthy natural forces of depletion are abolished, there first occurs a rapid increase in the herd, whether it be deer on the Kaibab Forest (and in half a hundred other localities), moose on Isle Royale, or antelope on the Cocino National Forest. There follows swiftly an almost total destruction of the food supply, or vegetative base. Starvation then sets in, accompanied by disease and malformations, dwarfing of stature, and general ruin of the species. The carrying capacity is permanently lowered and the public deprived of the sight of even the normal number of animals for decades to come. As foresters we speak not from theory but from experience. Had it been possible in any other way than by such horrible examples to overcome the obstacles of single-minded opposition by nature lovers, state control of game laws by politicians, and jealous guarding of universal rights of citizens to kill to the bag limit, the practice of regulated kills on such areas would have prevented these debacles without invoking the terrific reprisal of outraged nature, when her age-old balances are rudely upset by well-meaning but ignorant idealists.

One thing has, however, been demonstrated. Given proper protection, especially during the breeding season, and an adequate food supply, even such large animals as deer, elk, moose, antelope, and

bear will increase at an astounding rate, and may thus be made to furnish both spectacle and sport for our entire nation perpetually, if rightly managed. The same is true in even greater proportion for small game.

The forester's responsibility lies not in the general field of state game laws or regulations, nor in technical research, but rather in the management of forests directly under his control, whether this be national, state, or private. In this domain he can avoid the "deserts" caused by large even-aged stands of conifers, for instance, by resorting, as he would for other sound reasons, to the breaking up of age classes, and the creation of all-aged forests and stands. Coniferous plantations while lacking in food, provide indispensable protective cover and, when of small area and dispersed among hardwood forests, greatly increase the game total of both large and small species. Forest margins and openings and many species of food-bearing trees and shrubs can be favored with no loss to commercial production of timber. An adequate number of "coon" trees per square mile might easily be spared in improvement cuttings, but no one need worry about squirrels! These and many other relationships are easily and readily worked out on any forest area over which the forester has control, including the indispensable game sanctuaries of proper size to permit of protection without creating the havoc of overproduction.

The other side of the picture is worth a glance. Game, both for recreation (sight) and sport offers a direct satisfaction to the individual of his need for relaxation, and as such possesses the enormous emotional appeal that a two weeks' vacation offers as contrasted with fifty weeks of grinding office toil. So strong is this sentiment that, were it not for the

contest between the sight-seers and the killers, on the one hand, and the fact that practically every game enthusiast is a dogged individualist in his opinion, on the other, the force of the game interests in public affairs would be well nigh irresistible; and the only hope of the forester would lie (as in fact it does) in his advocacy of natural laws and methods, which constantly support his contentions by demonstrations of their soundness. But even in older countries, such as Germany, foresters have leaned far towards the maximum production of game regardless of damage to the forest, and have as a consequence been forced to resort to expense in protecting reproduction from extermination by browsing, that would be impossible in America for decades to come. At the meeting of the German Society of Foresters in the summer of 1935, a resolution was unanimously and enthusiastically endorsed to the effect that the total population of game in the German forests must be considerably reduced if the public expected these forests to continue to produce a reasonably adequate crop of timber for the use of the nation.

The crux of the situation here will lie in the possible damage by browsing, to the reproduction of trees. Already many examples have occurred of plantations decimated by winter browsing of deer. With proper coördination of forest management, including the provision for abundant supply of preferred foods (deer do not eat evergreens by choice) and the prevention of ruinous over-population by a regulated kill, it will be possible to raise, not the maximum of wood alone, nor yet the greatest number of game animals, but the maximum crops of both trees and game taken as a whole, on areas on which no one interest is allowed to dominate and destroy the rights and welfare of all others, but which are managed for the greatest good of all, in perpetuity.

WESTERN FORESTRY AND CONSERVATION ASSOCIATION ANNUAL MEETING

The following account of the recent meeting of the Western Forestry and Conservation Association is a compilation by the Managing Editor from the reports received from different members of the Society of American Foresters who were in attendance. One of our Council Members, Emanuel Fritz, who represented the redwood interests at the conference, concluded his report with the comment, "Several foresters suggested it was the type of meeting the Society of American Foresters should put on."

WHAT is generally conceded by the foresters and lumbermen attending it to have been the most constructive meeting of the many annual gatherings of the Western Forestry and Conservation Association convened on December 11, at Portland, Oregon, and lasted three days. This year's meeting is particularly notable for several things: (1) the inclusion on the program of papers reporting on the developments in forest practice on private lands under the Lumber Code and since its demise; (2) a more understanding feeling between forestry and the lumber industry; (3) the recognition of the importance of the meeting by the special trips from Washington of the Chief of the United States Forest Service and the Chief Forester of the National Lumber Manufacturers Association; and (4) the sustained interest of a registration of over 180 men representing the industry, protective associations, public agencies, and miscellaneous interested groups.

Foresters representing the Western pine, Douglas fir, and redwood regions explained what progress had been made since Article X of the Lumber Code became effective on June 1, 1934, as well as some of the problems they have had to meet in effectuating the adopted forest practice rules and those that are still to be solved before the full realization of acceptable practices can be attained. All reported genuine and increasing interest on the part of the operators and substan-

tial progress in actual forest practice improvement in the woods.

Mr. G. F. Jewett, as President, opened the meeting by saying that the industry was anxious to discuss many matters with the Chief Forester, to assure mutual understanding and confidence. "The industry does not willingly seek to bargain with the government. It asks only that the government try to encourage what industry has that is good and by precept and leadership remove the artificial barriers which make further progress so difficult. Without any spirit of defiance whatever, I assert that real progress can be had no other way. . . . I think with proper leadership we have the opportunity to organize our forests on a sustained yield basis. . . . I think the chief obstacle to this at present is the attitude of government. It has embarked upon programs which cast great doubt upon the wisdom of private forest investment."

Mr. Jewett asked Chief Forester Silcox just how far he believes government operation of logging and sawmills should go; also to what extent he believes that forest lands now in private ownership should remain there, to be managed for forest crops. He stated that the lumbermen would like to know to what extent Mr. Silcox would assume the leadership to see that forest taxation is reformed, and that credits are made available; and the extent to which he would work to secure tariff protection. In conclusion, Mr. Jewett said: "I do not recite these examples of government intrusion to show

my rugged individualism. I recite them because I think people, and the liberties of people, are more important than trees."

Mr. E. T. Allen, Forest Counsel, discussed the necessity of approaching the problems of today with candor and realism, because private, state, and federal agencies have been working together for 26 years in the West with conspicuous success, and not even a New Deal, with its ambiguous nomenclature, can change the facts or destroy the value of this method.

Speaking extemporaneously, but with evident thought and frankness, Mr. Silcox outlined the function which he believes the Forest Service should perform for the public, in cooperation with private industry. "There is no necessity for the government engaging in business whenever private business can do the job and provided private industry recognizes public interests and protects those interests," said Mr. Silcox. "This social responsibility has to be met. It is my conviction that we have to face in this country a more economic handling of our forests. My hope is to work out an integrated program of private and public enterprise which will make private sustained yield timber operation possible and afford security to communities and economic structions."

Remarks of Mr. Silcox were in reply to those who sharply questioned the intentions of the federal government in extending its forest control. "My ideas on the importance of democratic institutions are the same as yours. They are the most valuable possession we have, more important than trees," he said, "but I can't conceive of any better way to strengthen these institutions than to pursue a forest policy that will stabilize forest values and offer permanency to forest dependent communities."

Mr. Silcox described current and proposed activities of the Forest Service in

cooperation with organizations of private forest owners, to carry out the recommendations made two years ago by the Article X Forestry Conference. Included in legislative proposals backed by the Forest Service are the Fletcher Forest Credits Bill and the newly drafted National Forest Conservation Bill, the latter including provisions for increase of Clarke-McNary fire money authorization and large scale forest acquisition. In giving assurance that it is his desire to make use of acquisition funds in a reasonable measure to promote sustained yield forestry in the Northwest and stabilize timber values, Mr. Silcox asked for suggestions. He concluded as follows: "The Forest Service is essentially a democratic institution, highly decentralized and working out on the ground the problems that come up. Forest Service employees are local men whose natural viewpoint is a local one. With this set-up and a cooperative organization like the Western Forestry and Conservation Association, it should be possible at all times for these men, familiar with the problems, to sit around the same table and thresh out the difficulties that arise."

Complying with the Chief Forester's request, David T. Mason, Manager of the Western Pine Association, discussed the public acquisition of forest land. He stated that in his judgment, the public needs a *suitable*, not a maximum degree of forestry practice applied under the principles of the American system at a minimum cost. This means practice that is ample, but not needlessly so, to furnish our needs from the forest.

There are, Mr. Mason said, certain obstacles so far preventing the application of forestry to forest lands. These include unsound taxation, insufficient protection, the lack of suitable credit system, the lack of technical knowledge, too much threatening and not enough cooperation from public officers, and finally,

an overburden of timber in private hands in some places. Maximum progress toward the realization of public benefits depends upon the removal of these obstacles.

Public acquisition, Mr. Mason continued, can contribute most effectively not by buying denuded lands at minimum prices, not by buying solid areas for 100 per cent publicly owned sustained yield units, not by making the best money investments in regions where private ownership needs but little help, but by acting primarily in regions where the ownership problem is most acute, with greatest pressure for premature liquidation, and where such liquidation hinders the progress not only in that region, but in other regions. Major Mason recommended an acquisition policy which would approach the problem unit by unit, seeking to work out mutual undertakings with the idea that private owners and operators would carry as much as practicable of the timber, and the public would acquire the remainder, to be put in cold storage for future operation; one of the conditions of such an arrangement being an agreement to operate on a sustained yield basis. The public should go only so far as necessary, first because of the large sums of money required, and secondly, because complete public ownership would be a 100 per cent departure from what both Mr. Jewett and Mr. Silcox have defined as the "American system."

Colonel W. B. Greeley, Secretary-Manager of the West Coast Lumberman's Association, led a discussion of "Needed Cooperation Between the Public and Industry in a Forest Conservation Program," presenting a background of forest ownership facts derived from a survey recently conducted by the technical personnel of his office. He emphasized the fact that government and industry are making a fresh start in their cooperative attack upon national forestry problems;

that the industry (as far as Douglas fir is concerned) accepts the responsibility for leaving its cut-over lands safe from fire and in good growing condition, and will carry out voluntarily the obligations assumed under the Lumber Code. In his judgment, the big field for cooperation now lies in bringing about the economic security which must accompany social security, thereby making it possible for forest management to go out of liquidation and into sustained yield. Colonel Greeley also urged, as an immediate acquisition program in the Douglas fir region, special consideration of second-growth areas, representing between 40 and 50 billion feet of privately owned Douglas fir timber now being prematurely cut, also undeveloped holdings of mature timber in danger of liquidation, of which there are 60 to 75 billion feet in Oregon alone. He also advocated correlating acquisition plans of state and federal governments and said that he thought the income needs of the counties might be met some from payments on account as advances from the 25 per cent gross yield tax on National Forest receipts.

Forest practice developments since the demise of the Lumber Code in the three West Coast regions were described by Russell Mills for the West Coast Lumbermen's Association, Clyde Martin for the Western Pine Association, and Emanuel Fritz for the California Redwood Association. John B. Woods, forester for the National Lumber Manufacturers Association, reviewed conservation progress under the Lumber Code and sketched the national organization of voluntary conservation effort since the Schechter decision. While no legal basis exists for the regulation of forest practices, and while of course the organized associations do not include all operators, it is evident that the industry is determined to carry forward its share of the joint conservation program, and that marked progress

has been made on the West Coast.

In discussing the Oregon and California land grant situation, Mr. George Gerlinger presented a draft of proposed amendments to the Chamberlain-Ferris Act. He characterized this proposal as follows: "I believe this to be the least controversial proposal so far made and that if enacted, it will immediately bring into effect a definite sustained yield program for a very large portion of western Oregon."

Discussion of public operation of mills and logging was led by Mr. George L. Drake. Other topics discussed were: "Forest Taxation," led by Mr. S. R. Black; "1935 Fire Season and Its Lessons," E. H. McDaniels; "Clarke-McNary Law Cooperation," H. C. Shellworth.

Some difference of opinion developed over the question of the effectiveness of the C.C.C. as a protection agency. Mr. Charles S. Cowan expressed clearly his

fear that the threat of making the E.C.W. a substitute for Clarke-McNary appropriations may be realized with overwhelming damage to a permanent fire protection set-up. He concluded: "Splendid as is the C.C.C. in concept, it is still not the force which can take the place of properly trained local men organized for permanent protection control. The C.C.C. was not organized with this in mind. No one would logically organize 400,000 men permanently in order to take the place of possibly three or four thousand men normally employed with Clarke-McNary funds. We are dealing with a temporary organization, and it is obviously dangerous to break down the foundation upon which a true forest structure must arise."

Resolutions adopted covered the entire range of topics discussed. In addition a vote of thanks was tendered Mr. Silcock for making the transcontinental trip especially for this meeting, and for entering frankly and sincerely into the discussion.



A RULE OF THUMB FOR THE DECIMAL "C" LOG RULE

A RULE of thumb has been found that so closely approximates to the Decimal "C" rule that it can be used in any case with not more than 2 per cent error. A hint of this possibility was suggested while scaling logs in Texas by the Decimal "C" and Doyle rules on the same lot of logs. The custom in the use of the Doyle rule there is to include bark on both sides of the log, which adds nearly an inch to the scaling diameter. Often a lot of logs would show the same total board feet by either rule. In effect this meant deducting 3 inches from the measured diameter of the log instead of the usual 4 for the Doyle rule.

The rule of thumb is:

- (1) For logs of diameter 8" to 17" inclusive:

$$\text{Bd. ft. scale to nearest 10 bd. ft: } \frac{(D-3)^2 L}{4}$$

D: Scaling diameter of log

L: Length of log

- (2) For logs of diameter 18" to 27" inclusive:

$$\text{Bd ft. scale to nearest 10 bd. ft: } \frac{(D-3)^2 L}{25}$$

4

- (3) Above 27" no rule of thumb seems applicable.

W. R. BECTON,
District Ranger, Pike N. F.

FORESTRY ON THE WHITNEY PRESERVE IN THE ADIRONDACKS

By A. B. RECKNAGEL

Cornell University

Nearly forty years have passed since Dean Henry S. Graves (then with the Division of Forestry of the U. S. Department of Agriculture) started the forestry work on the Whitney Preserve in the Adirondacks (1). How well his prediction has worked out a recent growth study of the spruce and fir on the Preserve has shown (2). The following article deals briefly with forest management on the Preserve.

IN 1897 the late William C. Whitney acquired a block of 68,000 acres of Adirondack forest in the Town of Long Lake, Hamilton County, New York. It was practically virgin timber of white pine, red pine, red spruce, fir, hemlock, beech, yellow birch, and maple. The white pine was confined to the numerous lake shores and stream courses, and was often of very large size. The red pine, only less large than the white pine, was more limited in occurrence. Tamarack, cedar, black spruce, and miscellaneous hardwoods were minor components of the forest.

Graves (1) estimated that the swamp occupied 20 per cent of the area, the spruce flats 30 per cent, the hardwoods 10 per cent, and the spruce slopes only 10 per cent. Logging, before Mr. Whitney acquired the land, had been limited to a light culling of the pine and spruce. There had been little or no damage by fire, and the area, as a whole, presented a picture of unbroken forest in a rolling terrain dotted with lakes and ponds.

Following Graves' recommendations, logging began in 1898 for the species merchantable at that time, namely, spruce and pine, with a selection cutting to a flexible 10-inch minimum diameter limit at least high. All trees to be cut were to be marked in advance of logging; enough spruce seed trees over 9 inches d.b.h. were to be left to provide ample reproduction of spruce. Low stumps,

close utilization of the trees cut, and care in logging to avoid damage to existing young growth were other features of the plan. A second cut of spruce equal in amount to the first was forecast at the end of 36 years, a prediction which has been fulfilled. (2)

Although Graves' personal supervision ended after the first year, his plan was followed (albeit without marking or other technical supervision) until the final cutting in 1909. Then for 25 years no further cutting occurred, except for local fuel wood and the like. During the interim, excepting the disastrous fire years of 1903, 1907, and 1913, the protective system of lookout towers, telephones, and observers has functioned satisfactorily. In 1903 some 4,000 acres were burned, and the total acreage made barren by forest fires is about 7,000 acres. Because of additional purchases, the productive acreage now totals 73,500 acres of cut-over land restocking satisfactorily, 760 acres of virgin forest, and about 1,000 acres of roads, water surface, cleared land, and miscellaneous, bringing the present total of the Whitney Preserve to 82,260 acres.

Unfortunately, few or no data are available as to the stand and stock on the area as a whole. No detailed forest survey or timber estimate has ever been made. In June, 1920, James W. Sewall estimated 257,000 cords of spruce and fir 5 inches d.b.h. and up. Assuming a

current annual increment of 2.3 (3) per cent, the present volume of spruce and fir on the cut-over land is about 350,000 cords with an additional 11,400 cords on the virgin area. These figures are conservative, and it is likely that the actual stand of spruce and fir is close to half a million cords. Sewall also estimated the hemlock (7 inches d.b.h. and up) at 225,000 cords and the hardwoods at 206 million board feet. Both of these figures are conservative.

In 1934 the owners resumed cutting of the spruce, and also began to harvest the fir and the hardwoods. A preliminary working plan was prepared by the writer in May, 1934, which advocated a selection cutting with approximate breast-high diameter limits of 8 inches for spruce, 7 inches for balsam fir, 10 inches for hemlock, and 12 inches for hardwoods. The plan was to mark all softwood trees

for removal before cutting, but time and other exigencies have so far precluded the carrying out of this very desirable practice.

Although the first year's cut removed only 7,700 cords of spruce and fir pulpwood and 1,377 M. board feet of hardwood sawtimber, and although the operations for the current year are for only 12,000 cords of spruce and fire pulpwood and 2,500 M. board feet of hardwood sawtimber, the owner hopes to cut over the entire area on the basis of a 10-year working period, which would permit an annual cut of 40,000 cords of spruce, fir and hemlock and 20,000 M. board feet of hardwoods. The growth study of 1933 (2), and Finch, Pruyn & Company's long time experience on similar land (3), indicate that for the pulpwood species the next cutting cycle could be shortened to 25 years; but for the sake of conservatism it will be kept at 35 years. No local data are available on the growth rates of hemlock and hardwoods.

If, during the cuttings beginning at the present time, the management of the Whitney Preserve will leave the spruce below 9 inches d.b.h. and the balsam fir below 8 inches d.b.h., the yearly growth of pulpwood will average 0.18 cord per acre on the cut-over land (about one-fifth of a cord) or, for the 73,500 acres of productive land, 13,230 cords yearly throughout the ensuing cutting cycle of 35 years. This, at 90 cubic feet per cord, is a current annual growth of 1,190,700 cubic feet per acre of spruce and fir which compares well with other Adirondack areas under management (3). Periodic sustained yield of the spruce and fir, therefore, seems assured, but it will be checked by means of carefully established permanent sample plots on cut-over land whereby the progress of restocking and of growth can be determined accurately.

The first of such a series of permanent



Photo by J. D. B. Harrison
Sample plot, Sept., 1935, on Whitney Preserve
in Adirondacks, cut over for pulpwood, June,
1935. Spruce and fir only taken to 8 inches
d.b.h.

sample plots was established on September 16, 1935, in a typical area of softwood flat, cut over in June, 1935. The accompanying photograph shows the residual stand. The measurements, per acre, showed the following:

Cut:

Spruce, 22 trees, volume 5.92 cords

Fir, 26 trees, volume 7.84 cords

Total, 48 trees, volume 13.76 cords

Left (5 inches d.b.h. and up):

Spruce, 38 trees, volume 1.32 cords

Fir, 26 trees, volume 1.32 cords

Total, 64 trees, volume 2.64 cords.

The smallest trees cut were 8 inches d.b.h.; the largest, 17 inches d.b.h.

Besides these two species, there were left, standing per acre, the following, 10 inches d.b.h. and up:

Hard maple, 4 trees, volume 740 board feet.

Red maple, 2 trees, volume 360 board feet.

Yellow birch, 26 trees, volume 3,080 board feet.

Hemlock, 4 trees, volume 1,906 board feet.

Miscellaneous hardwoods, 2 trees, volume 180 board feet.

Total, 38 trees, volume 6,266 board feet.

It is interesting to compare these figures for spruce and fir with the average stand in the same locality, as measured before cutting (2) which showed 79

spruces, 5 inches d.b.h. and up, per average acre (as against 60 on the sample plot) and 56 firs, 5 inches d.b.h. and up, per average acre (as against 52 on the sample plot); a stand of 14.79 cords per average acre (as against 16.40 cords on the sample plot) and an estimated average removal of 11.13 cords per acre (as against 13.76 cords actually cut on the sample plot).

The main objectives for the Whitney Preserve are: first, a forest survey, second, a detailed working plan, and third, technical direction of its execution, including the marking of all softwood trees in advance of cutting. With these attained, it is a unique example of a large forest area with opportunity for long-time sustained yield management under private ownership.

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FOREST SCHOOL STATISTICS FOR 1935: DEGREES GRANTED AND ENROLLMENTS

By CEDRIC H. GUISE

Cornell University

TO supplement the statistical material contained in earlier reports dealing with the numbers of degrees conferred for studies completed in forestry, and the annual forest school enrollments, the heads of the forest schools in United States were circularized last fall for the 1935 statistics.¹

The following presentation shows the numbers of degrees granted for the calendar year 1935, and the enrollments for the first term of the academic year 1935-1936. For purposes of comparison and analysis, annual statistics for the period 1902 to 1935 are also presented. In addition are some of the important recent developments in forest school education in the United States.

DEGREES GRANTED

In Table 1 are shown for each of the forest schools in United States the numbers of undergraduate, Master's, and Doctor's degrees conferred for completion of studies in forestry for 1935. In Table 2 are presented, for each of the years 1902 to 1935 inclusive, the total number of undergraduate and Master's degrees conferred.

During 1935, there were conferred 411 Bachelor's degrees, 58 Master's degrees and 8 Doctor's degrees. The total of 411 is an increase of 76 over the number granted in 1934, and is the largest number ever reported for any one year, although only 19 more than the 394 listed for 1931. Nevertheless the trend is, for the immediate future, distinctly upward and during the next four or five years all indications point to a continued increase of considerable proportions. The large increase in undergraduate enrollments of the past two years will not be fully reflected in the number of degrees conferred until 1937, but in that year, and during the years immediately following, even allowing for a high student loss, the numbers of men to graduate will be far beyond those which have been reported to the present time. The forest school staff are certain to be faced with difficult, if not impossible, problems of placement of graduates. As shown in Table 2 the total number of men who through 1935 have received undergraduate degrees for work completed in forestry is 6,697.²

The number of Master's degrees reported for 1935 is 58, an increase of 11 over 1934, but a total which is considerable.

¹Forest education, Henry S. Graves and Cedric H. Guise, Yale Univ. Press, 1932.

²Degrees granted, enrollments and recent developments at the forest schools in the United States 1931-1933. Cedric H. Guise, Jour. For., 32:3.

Forest school statistics for 1934: Degrees granted and enrollments. Cedric H. Guise, Jour. For., 33:4.

³Statistics for Duke University were received after the submission of this article. A total of 20 pre-forestry undergraduates were enrolled, there being 6 freshmen, 7 sophomores, 4 juniors and 3 seniors. Enrolled as graduate students were a total of 9 men; candidates for the degree Master of Arts include one major in forestry and 4 minors; registered for the degree Doctor of Philosophy are one major in forestry and 3 minors. No degrees, graduate or undergraduate were conferred in 1935.

ably below the 97 of 1931, the maximum number reported. Higher figures were also reported for 1911, 1928, and the years 1930 to 1933 inclusive. For the immediate future there is no indication of appreciable increase in the numbers of men to receive Master's degrees. Occupational opportunities are still sufficiently good to draw and hold most of the recent graduates into employment. When employment opportunities become restricted, it is highly probable that there will be a great increase in the numbers of men working for Master's degrees. In all, for the period 1902-1935, a total of 1,425 Master's degrees have been granted. In 1935, there were 8 Doctor's degrees conferred, bringing the total through this year to 61.

TABLE 1

NUMBER OF DEGREES GRANTED FOR COMPLETION OF STUDIES AT FOREST SCHOOLS IN THE UNITED STATES FOR THE CALENDAR YEAR 1935

Forest school	Under-graduate degrees	Master's degrees	Doctor's degrees
1. California	30	2	-
2. Colorado State	21	-	-
3. Connecticut	6	-	-
4. Cornell	18	1	-
5. Georgia	10	-	-
6. Harvard	-	5	-
7. Idaho	27	6	-
8. Iowa	21	-	-
9. Louisiana	5	-	-
10. Maine	20	-	-
11. Michigan State	21	-	-
12. Michigan University	16	13	-
13. Minnesota	41	1	-
14. Montana	8	-	-
15. New Hampshire	4	-	-
16. N. Y. State College of Forestry	64	8	1
17. North Carolina	22	-	-
18. Oregon State	16	-	-
19. Pennsylvania State	19	-	-
20. Purdue	11	-	-
21. Utah	11	-	-
22. Washington State	8	-	-
23. Washington Univ.	14	3	-
24. Yale	-	19	7
Totals	413	58	8

While it is almost impossible to give exact statistics without extended study to account for duplications, it is probable that the total number of men who have received degrees for professional instruction in forestry is approximately 7,500.

The New York State Ranger School reports 34 graduates in 1935. Added to the statistics formerly presented, the total number of certificates granted for completion of the ranger course at this school is 499.

TABLE 2

NUMBER OF DEGREES GRANTED FOR COMPLETION OF STUDIES AT FOREST SCHOOLS IN THE UNITED STATES FOR THE CALENDAR YEARS 1902-1935

Years	Undergraduate degrees	Master's degrees
1902		9
1903	1	14
1904	4	29
1905	9	34
1906	23	24
1907	18	27
1908	31	35
1909	47	44
1910	61	48
1911	100	61
1912	122	54
1913	136	37
1914	151	42
1915	124	35
1916	151	36
1917	160	27
1918	65	10
1919	53	6
1920	160	25
1921	126	26
1922	141	44
1923	217	31
1924	215	43
1925	280	44
1926	259	58
1927	263	50
1928	302	64
1929	291	54
1930	308	69
1931	394	97
1932	380	78
1933	355	65
1934	337	47
1935	413	58
Totals	6,697	1,425

ENROLLMENTS

Extraordinary increases appear in the undergraduate enrollments for the current year. In 1934-35 the first term enrollment was 3,791, an increase of 1,548 over the five-year mean of 2,243 for the years 1929-30 to 1933-34. When the statistics for last year were compiled, it was thought the figure of 3,791 was almost the maximum undergraduate registration to be expected. But for the first term of the current year the comparable figure is 5,406. This figure is an increase of 1,615 over the enrollment of 1934-35, and an increase of 3,163 over the five-year mean of 2,243 previously mentioned. It is unnecessary to present here extended percentage analyses. The facts are apparent upon examination of Tables 3, 4, and 5. Table 3 shows for the period 1903-04 to 1935-36 the total annual undergraduate enrollments at all forest schools in United States; Table 4 presents the enrollments by classes at each Forest School for the current year; and Table 5 shows for each year, for the period 1929-1930 to 1935-1936, the undergraduate enrollments by classes for all forest schools, including the ratio of seniors to freshmen.

TABLE 3

UNDERGRADUATE ENROLLMENT AT FOREST SCHOOLS
IN THE UNITED STATES, 1903-04 TO 1935-36

Year	Enrollment	Year	Enrollment
1903-04	19	1919-20	927
1904-05	39	1920-21	1,092
1905-06	51	1921-22	1,363
1906-07	98	1922-23	1,347
1907-08	143	1923-24	1,439
1908-09	258	1924-25	1,624
1909-10	357	1925-26	1,771
1910-11	518	1926-27	1,880
1911-12	591	1927-28	1,957
1912-13	637	1928-29	2,079
1913-14	868	1929-30	2,123
1914-15	904	1930-31	2,120
1915-16	944	1931-32	2,573
1916-17	897	1932-33	2,388
1917-18	560	1933-34	2,246
1918-19	498	1934-35	3,791
		1935-36	5,406

In examining these statistics attention should be called to the fact that the University of Michigan lists only juniors and seniors, and the University of California a number of freshmen and sophomores which is comparatively low in relation to the numbers in the two upper classes. As reported in former articles, California and Michigan are concerned primarily with upperclassmen, and expect to receive men for the junior year from junior colleges, from other colleges and universities by transfer, as well as from the student body of their own institutions. If statistics for the freshmen and sophomore classes at California and Michigan were on a comparable basis with those of other institutions, the total enrollment for the current year would probably be increased by several hundred underclassmen.

Cornell lists only members of the senior class; undergraduate instruction in forestry of professional grade at this institution will terminate in June, 1936.

Trends in undergraduate enrollments are shown in Table 5, where the undergraduate enrollment statistics by classes for all schools are shown for each of the last seven years. The totals varied little for the years 1929-30 to 1933-34, the average for those years being 2,243. Last year an increase of 1,548, equivalent to 69 per cent, over this average of 2,243 occurred, and for the current year as previously mentioned the increase over this average is 3,163, or 141 per cent.

The average for the five years 1929-30 to 1933-34 is selected as a base in view of the fact that there was little variation during those years, and because enrollments during those periods were not influenced by the great public interest created in forestry as a result of activities of the present federal administration.

A study of the figures in Table 5 will show that the increased registration in the

last two years is responsible primarily for the great increase in total enrollments. Nevertheless the present enrollment of juniors is 943, which is almost double the average number of 476 for the five-year average 1929-34. Further, the number of men in the senior class, 575, most of whom will graduate next June, is 136 above the 439 listed for 1934-35, and 177 more than the five-year average.

The numbers of men reported as candidates for Master's and Doctor's degrees are slightly higher than the corresponding figures for the last year. In 1934-35, 104 men were candidates for the Master's degree; for the current year the number is 114. The number listed as candidates for the doctorate is 25, as compared with 18 last year. The division of men into the two classes is not entirely satisfactory, inasmuch as some men registered for one

degree are also candidates for both. In any event, there were 139 men reported as registered for advanced degrees. This figure may be compared with those of 122 for 1934-35, 117 for 1933-34, 206 for 1932-33, and 199 for 1931-32.

The New York State Ranger School reports 59 men registered for the current year. At Pennsylvania State College, 48 men are enrolled in the first year of the ranger course and 18 for the second year.

While this article is primarily a presentation of factual material, it may not be out of place to comment briefly on the problems with which forest schools will be confronted as a result of the abnormally high enrollments of the past two years. When the total enrollments were between 2,000 and 2,500 it was apparent that a considerable number of forest schools were inadequately financed, staffed,

TABLE 4

ENROLLMENT BY CLASSES AT FOREST SCHOOLS IN THE UNITED STATES—FIRST TERM 1935-36

Forest school	Freshmen	Sophomores	Juniors	Seniors	Total under-graduates	Graduates Masters-Doctors		Special students
1. California	66	51	80	55	252	22	3	—
2. Colorado State	190	97	62	44	393	—	—	—
3. Connecticut	10	10	8	7	35	—	—	—
4. Cornell	—	—	—	17	17	8	5	—
5. Georgia	60	67	48	19	194	—	—	—
6. Harvard	—	—	—	—	—	2	—	—
7. Idaho	141	98	51	29	319	1	1	2
8. Iowa	136	84	38	19	277	—	—	2
9. Louisiana	61	47	23	7	138	—	—	2
10. Maine	47	40	25	16	128	—	—	1
11. Michigan State	160	77	43	17	297	1	—	—
12. Michigan Univ.	—	—	59	27	86	18	7	3
13. Minnesota	198	177	40	23	438	—	—	11
14. Montana	142	90	35	19	286	—	—	3
15. New Hampshire	35	16	15	9	75	—	—	—
16. N. Y. State Col. of Forestry	150	125	92	96	463	17	6	—
17. North Carolina	95	61	42	24	222	1	—	—
18. Oregon State	191	150	36	24	401	8	—	—
19. Pa. State	146	119	66	37	368	—	—	1
20. Purdue	89	37	18	14	158	—	—	—
21. Utah	129	92	82	35	338	—	—	10
22. Washington State	70	43	22	11	146	—	—	—
23. Washington Univ.	185	106	58	26	375	4	1	10
24. Yale	—	—	—	—	—	32	2	1
Totals	2,301	1,587	943	575	5,406	114	25	46
Number of schools	20	20	21	22	22	11	7	11

and equipped. At present many schools have doubled and tripled what would be normal enrollments, without anything like commensurate increases in facilities for instruction. At present, as has been pointed out, the greater increases are still found in the freshman and sophomore classes, where the instruction is for the most part supplied by allied departments in the colleges or universities with which the forest schools are associated. Next year will, unless an unusually heavy mortality occurs, find large increases in the junior class, where a considerable if not a major part of the professional subjects will be taught. This means large classes and extraordinarily heavy loads on the forest school instructors. To speak frankly, will it not result inevitably in a distinct lowering of quality of instruction? Certainly those in the various schools, who of course can not, except in a few cases, control the number of men to be received as forest school students, have every reason to be disturbed over a problem which has already become serious, and which gives every indication of becoming increasingly difficult.

Further, what are the opinions of those in charge of forest schools in regard to

future placement opportunities? The classes graduating in 1933 and 1934 obtained employment without difficulty—in fact were in many cases able to pick and choose. But the class of 1935 found a more restricted employment field, although a majority of the men who graduated last June are probably placed. No considerable number obtained work in Civilian Conservation Corps camps on the basis of the doubling of the number of camps. Press notices carry the news that the permanent plans for these camps call for 300,000 men—the number enrolled before the expansion took place a year ago. Nor is there the slightest evidence that public activities in forestry are going to continue to expand in a manner which will call for any increased technical personnel. Further, the private industries are not in the mood for extensive employment of young foresters. If this line of reasoning is correct, there is within a very few years going to be a large number of young foresters graduated, who will have little opportunity of employment, a situation similar to that which confronted the men completing their college courses in 1931 and 1932. Naturally such a situation will result in:

TABLE 5

UNDERGRADUATE ENROLLMENT, BY CLASSES, AND RATIOS OF SENIORS TO FRESHMEN, IN FOREST SCHOOLS IN THE UNITED STATES FOR THE YEARS 1929-30 TO 1935-36

Academic year	Enrollment					Ratios in percent seniors to freshmen
	Freshmen	Sophomores	Juniors	Seniors	Total ¹	
1929-30	695	573	451	352	2,071	57
1930-31	620	565	434	377	1,998	60
1931-32	964	598	530	444	2,536	46
1932-33	811	619	497	448	2,375	55
1933-34 ²	775	628	467	368	2,235	58
1934-35 ²	1,751	930	671	439	3,791	25
1935-36 ²	2,301	1,587	943	575	5,406	25
Average 1929-34	773	597	476	398	2,243	51
Increase 1934-35	978	333	195	41	1,548	
Increase 1935-36	1,528	990	467	177	3,163	
Increase 1935-36 per cent	198	166	98	44	141	

¹Special students excluded.

²First term enrollments.

rapid deflation of forest school enrollments. Yet there is certain to be an early period when many, probably the majority, of men who graduate from forest schools will be without opportunity for employment. This situation will be of little comfort or credit to the schools. It would have been wise if steps had been taken as early as 1934 to limit severely the size of the entering classes.

CHANGES AND DEVELOPMENTS

Changes in the administrative heads of two forest schools may be noted. Professor D. S. Jeffers, formerly at the College of Forestry at the University of Washington, was appointed Dean of the School of Forestry at the University of Idaho, succeeding Richard E. McArdle, who is now head of the Rocky Mountain Forest Experiment Station. Paul M. Dunn succeeds Thornton G. Taylor as head of the School of Forestry at Utah State Agricultural College.

New developments in the establishment of forest schools and pre-forestry courses should be recorded. Ohio State University, which has for some years had a two-year pre-forestry course, has just added a third year to the curriculum. Plans are being considered for the establishment of a complete four-year course. The forestry work at Ohio State is in charge of Professor E. G. Wieseheugel.

The University of Florida has initiated both a two-year course for training forest rangers and a full four-year undergraduate curriculum of professional grade. The ranger course is open to men who have been employed in forestry activities, and who can meet the regular entrance requirements of the University. The work taken does not count toward a university degree. Upon the satisfactory completion of the first year curriculum and a summer camp, an appropriate certificate will be awarded. The granting of a ranger's

certificate will follow the completion of a second year of prescribed studies.

The four-year curriculum is also definitely organized. It includes an eight weeks' summer camp between the third and fourth years. During the current year courses in general forestry and dendrology are being offered. In charge of the organization of the work in forestry at the University of Florida is Professor H. S. Newins, who for the past several years has been on the forest school faculty of Michigan State College.

A Forestry Division has also been established at West Virginia University. Pursuant to an order of the Board of Governors of West Virginia University, May 10, 1935, the College of Agriculture has established a two-year course in which the principles of land-use and practices of forestry will be taught. The order is quoted as follows from the announcement of "Courses in Forestry" for 1935-36, West Virginia University Bulletin No. 17-1, dated June 1, 1935.

"Ordered that the first two years of a course in professional forestry be established in the College of Agriculture of a subject content that will allow students completing it to transfer to any standard professional forestry school and finish their training in two years; and that this course be expanded to a full four-year course in forestry on condition that additional funds necessary to provide facilities for teaching the third and fourth years be appropriated by state or federal agencies."

A complete four-year schedule of courses has been planned, including a summer camp of ten weeks between the second and third years. The work is organized temporarily as the Forestry Division of the Biology Department of the College of Agriculture. While the two-year course has been established, the third and fourth years are anticipated

only and will not be established until additional funds are provided. The organization of the work in forestry at this institution is under the direction of Professor W. C. Percival.

The University of Missouri will initiate a two-year pre-forestry curriculum, probably starting in 1936. Professor R. H. Westveld, of Michigan State College, has accepted a position on the faculty at the University of Missouri to take charge of the establishment of the curriculum.

In the JOURNAL OF FORESTRY for December, 1935, appears an article to the effect that the Department of Forestry at the University of Georgia has recently

been raised to the status of a School of Forestry.

In preparing this annual presentation of statistical material, it is recognized that considerably more information of worth while character might be obtained and included. However, an exhaustive treatment of the affairs of forest schools would be somewhat difficult to present annually. At five or ten year periods an amplified article might well be considered. Suggestions will be welcomed from anyone interested in forest education for the inclusion of additional statistical material which is readily obtainable annually from the forest schools.



NEW COMMISSIONER OF CONSERVATION IN MASSACHUSETTS

UPON expiration of the term of Samuel A. York as Commissioner of Conservation in Massachusetts, Governor Curley has appointed as his successor Ernest J. Dean, a member of the House of Representatives of Massachusetts since 1923. In the legislature he served on the committee on conservation for nine years and as chairman of the committee five years, and for four years was on the committee on harbors and public lands. In 1928 he was a member of a recess commission to study the shell-fish industry and recommend legislation; in 1929 was vice-chairman of another recess commission to revise and codify the inland fish and game laws; and in 1930 and 1931 served in the same capacity with respect to the Marine fishery laws. Also, he was for three years a member of the advisory board of the Director of the Division of Fisheries and Game, one of the units of the State Conservation Department, which includes also the Division of Forestry.

SOME FINANCIAL ASPECTS OF SILVICULTURE AND EMERGENCY RELIEF

By E. B. MOORE¹ AND A. T. COTTRELL²

New Jersey Department of Conservation and Development

AMONG the relief problems which New Jersey has faced during the depression years has been that of providing fuel for families on relief rolls. This need was met at first entirely by the purchase of coal, which was rationed out to "clients" in the same way that food and clothing were distributed.

Early in 1932, however, the need for exercising economy in the mounting relief costs led the Division of Forestry of the State Department of Conservation and Development to suggest to the Emergency Relief Administration the substitution of wood produced from silvicultural thinnings in the place of coal.

The machinery for handling such a program was already available in the "Work for Relief" system conducted by the relief authorities. This practice was based upon the principle that free public maintenance of able-bodied unemployed would tend to pauperize the recipient, thus lowering his self-respect. Each family receiving assistance was, therefore, charged with the cost of the food, fuel, rent, hospitalization, and other forms of relief received. When an account of \$20 had accumulated, the man was asked to liquidate the debt by working on an approved public project, for which he was credited at the usual rate of wages paid for such work in that vicinity.

The Forestry Division, through its contacts with the timberlands of the state, was familiar with privately-owned tracts on which thinnings and improvement cut-

tings would be of distinct silvicultural advantage, although it was not economically possible for the individual owner to undertake such work himself. The plan as prepared by the Forestry Division provided for the utilization of "Work for Relief" crews on woodland improvement projects under the direction of the state forestry personnel. The wood resulting from the thinnings would be taken over by the county relief officials for distribution instead of coal. It was felt that the property owner would benefit directly by the silvicultural improvement of his forest and the reduction of the fire hazard on his property. The state and the tax-paying public would gain by the difference between the amounts expended for coal and the actual cash outlay incidental to cutting and distributing the wood. This cost could not, of course, include the paper credits allowed the men in working off their relief accounts, because all relief was dispensed whether work projects were undertaken or not. Furthermore, under the law, even refusal to work on a project might not be penalized by stopping relief.

The main centers of relief need were located in the populous industrial sections of the northern and north-central counties. This area lies within the Piedmont Plateau and the Appalachian Highlands, where the oak-chestnut type predominates. Although New Jersey has been settled for some three hundred years, approximately 60 per cent of its area is

¹Senior Assistant Forester.

²Assistant Forester.

still in forest and many urban communities are located close to considerable tracts of woodland. Most of the stands, however, have suffered from fires and over-cutting so that defect and a poor distribution of diameter classes is very common. Thinnings similar to those proposed have been undertaken occasionally by individual owners. Due to the high wages, light cut, and low grade of wood produced, the income has been less than the cost of the work. Forest land in this particular section is held mainly for aesthetic, recreational, and future residential values, and it was believed that most owners would welcome the opportunity for silvicultural improvement in return for the wood removed.

INITIATING THE PROGRAM

In initiating this program it was necessary for the Forestry Division to convince the county directors of the Emergency Relief Administration of its practicability. At first the proposal elicited very little interest and even some opposition. It was felt that various borough improvements offered a better field of activity, particularly as the work could be done at considerable saving in labor cost to the municipal budget. However, such projects nearly always required considerable expenditures for materials; and as the town treasuries were usually empty, the state and county were frequently called upon to assist in financing these local improvements. The fact that a wood production project required a comparatively small outlay was a potent factor in its favor and ultimately helped to gain the approval of the E. R. A. However, soon after a few crews had started work in the woods, the reduction in relief costs for fuel was so apparent that the Forestry Division was swamped by requests for additional projects. To assist in the expansion of the program, the

state E. R. A. furnished funds for additional technical help, which was selected by and worked under the direction of the State Forest Service.

ORGANIZING THE WORK

In organizing the work in a county it was necessary first to obtain a list of municipalities where woods crews would be made available. This information was provided by the county E. R. A. The state foresters then made a survey of the woodlands in the vicinity of each designated town. This was done largely by car, supplemented by frequent foot excursions into the woods. Stands which would yield at least 4 cords per acre of thinnings were plotted on county road maps. Ownership, if not already known, was checked with the aid of local residents, tax collectors, and township engineers. When the problem of uncertain boundaries arose, surveys were made by the Forestry Division.

Wherever it was possible, contact with the owner was established by personal visit, otherwise by correspondence. More than 75 per cent of the owners approached readily gave their consent for the work. Projects once started in the community attracted very favorable attention, and in many cases requests were received from neighboring land owners to extend the work to their properties. In this way waiting lists were built up.

Written agreements were drawn up between each owner and the Department of Conservation and Development. These agreements covered the general type of work to be done, and gave complete discretionary power to the state foresters. The owner, however, reserved the right to terminate operations at any time should he so desire. This latter provision was never exercised.

MARKING AND SUPERVISION

The marking practice varied with the age and condition of the stand, and was applied to diameters as low as 2 inches. When the tract was even-aged and not yet mature, i.e., up to 60 years, the marking was from below under the German system, maintaining a closed canopy of dominants wherever possible. Pure stands of aspen occupying areas up to an acre in extent were clear cut, with the idea of providing the marginal conditions favorable for game. In over-mature stands, or where more than one age class was present, a general improvement cutting was made, removing some of the dominants and making openings to encourage seedling reproduction. Nothing merchantable was piled or saw timber was taken.

In disposing of the brush, the attempt was made to reduce the fire hazard on the area without at the same time seriously lowering the carrying capacity for game. For this reason, while most of the brush was piled and burned, a few scattered heaps were left here and there for cover. Occasionally on moist sites the brush was lopped and scattered. Thickets of undergrowth and shrubs were disturbed as little as possible. Where gully erosion had begun, dams were constructed with stones, decayed windfalls, and brush.

Marking was kept only a few days ahead of the crews, in order to prevent the skipping of unfavorably stocked areas, and each project was checked up once or

twice a week. To eliminate the cutting of unmarked trees, stump stamping was used on all diameters over 5 inches, material under this limit offering too little value as cordwood to tempt cutting violation.

TRANSPORTATION

In transporting the wood to points where it could be loaded on trucks a variety of methods were used. Man power, horses, and tractors were the most common. On steep, rocky slopes where the wood had to be brought up hill or across ravines, sky lines were rigged, using second-hand elevator cables and home-made trolleys. The power was furnished by trucks or by portable windlasses, which were constructed on the job and operated by hand. Wood was yarded in this way for distances up to 700 feet. On the whole, however, horses with the front trucks of ordinary farm wagons used as bummers were found to be the best means for getting the wood to loading points. The wood was usually handled in 12 or 16 foot lengths, and the skidding distances ranged up to $\frac{1}{4}$ of a mile. Power saws and gas engines were located at the loading points, where the wood was cut into stove lengths and taken away on trucks. The hauling distance to town averaged about 8 miles one way.

COST OF THE WOOD

In 1934 hard coal purchased by the

TABLE 1

SUMMARY OF COST DATA ON E.R.A. WOODS PROJECTS ON PRIVATE LAND FROM
JANUARY 1, 1935 TO JUNE 1, 1935

Number of projects	Number of cords cut (A)	Coal equivalent, tons ¹ (B) = A x 0.6	Coal equivalent, cash (C) = B x \$10.00	Cash cost in cutting & distributing wood (D) ²	Cash saving to state E. R. A. (E) = C - D
33	5720	3432	\$34,320.00	\$17,827.00	\$16,493.00

¹One cord green wood assumed to be equivalent to 0.6 tons hard coal.

²Includes the cost of trucks used part time on other projects, but charged entirely against the wood jobs by the E. R. A. The saving shown in column "E," therefore, is conservative.

Average cash cost per cord: \$3.11.

E. R. A. in New Jersey cost between \$10.00 and \$10.40 per ton. In order to obtain an idea as to the economic benefit of the wood-cutting work, the Forestry Division undertook the collection of cost data on all the projects operating from January to June, 1935. In so doing all expenditures by the E. R. A. were separated into two parts; "cash," and "debits." Under "cash" was listed all expenses which were incidental to the operation of the woods projects, such as foreman's pay, the hire of trucks, teams, saws and engines, and general miscellaneous items. "Debits" covered the "wages" credited to the men against their relief accounts. In computing the cost of the wood each week, the "debits" were not included, but only the actual "cash" expenditures, because as pointed out above, supplies were issued to all on relief rolls regardless of whether work projects were conducted or not.

In order to determine the fuel value of the wood in terms of coal, it was assumed

that one cord of green wood was equivalent to 0.6 tons of hard coal. From data furnished by the U. S. Forest Products Laboratory it was believed that this figure was fairly conservative, particularly as a certain amount of dry wood was nearly always included in the cut.

The "coal equivalent" in tons thus derived was appraised at \$10 per ton—the minimum market price for hard coal. The difference between this figure and the actual cash cost of cutting and distributing the wood, as shown in Table 1, was considered to be the saving due to the woods projects.

The operations summarized in Table 1 were carried out over a total of 900 acres of private land and represent a yield of 6.3 cords per acre. Thirty-one different properties were involved, including total forest ownership of 11,000 acres. Since this type of relief work began in 1932, about 2,500 acres of privately owned woodlands have been thinned, with proportionate results to those given above.

THE EUROPEAN SPRUCE SAWFLY IN THE UNITED STATES¹

By H. J. MacALONEY²

The spruce forests of the Northeastern States are threatened by a spruce sawfly, which may be even more serious than the spruce budworm of 20 years ago. The extent of the infested area is shown and the possibility of control by parasitization is discussed.

IN 1930 extensive stands of spruce in the Gaspé Peninsula, Quebec, were defoliated by an insect which subsequently was identified as the European spruce sawfly (*Diprion polytomum* Harbig). During the course of an intensive study in this area, by the Dominion Entomological Branch, it developed that this sawfly may have been present for many years. In 1934 the heavily infested area was estimated as 5,000 square miles and the lightly infested area at considerably more than that. As an indication of the devastation suffered, one widely known forester has stated that the damage done in this region is worse than that by any forest fire he has ever seen.

Because of the seriousness of this outbreak in Canada, the knowledge that this sawfly was already in New England, and the danger threatened to the spruce timber in the northeastern part of the United States, the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture undertook an extensive survey during the past summer to determine the extent and degree of infestation in this country. Before the survey started there were records of adult flies having been taken on Mount Washington, N. H., in 1929, on Mount Desert Island, Me., and North Andover, Mass., in 1931, and

at a few other points in New England. Of necessity the survey was very general and was carried out along roads which could be traveled by automobile. By no means were all these roads covered; but an attempt was made to get a good cross-section of the region where spruce would be found. Lack of time prevented examination of areas distant from these roads, and for this reason the state of Maine was not covered as thoroughly as was the remainder of the region. As the spruce sawfly was already known to be present in large numbers in that part of the province of Quebec bordering Maine, and was also present in the province of New Brunswick, the survey was initiated in Maine, with the intention of working westward as indications of the presence of the sawfly were found. Specimens of larvae, or evidences of feeding, were found in over 150 localities in New England and New York. The accompanying map (Figure 1) indicates the sections where the insect was found, and suggests that it is present where spruce occurs throughout the northeastern region.

At present the known southern limits are Orange, about 5 miles west of New Haven, Conn., and the Titicus and Kensico Reservoirs in Westchester County, N. Y. The known western limit is Syracuse,

¹Grateful acknowledgment is extended to the State Entomologist of Maine, New York State College of Forestry, the Conservation Department of New York, and the State Forestry Department of Connecticut for assistance in locating infested areas in these states; to the Dominion Entomological Branch for information concerning the extent of the infestation in Canada; to the Dominion Parasite Laboratory and the western laboratories of the Bureau of Entomology and Plant Quarantine for parasite material; and to Mr. G. H. Plumb of the Entomology Department of the Connecticut Agricultural Experiment Station for carrying on laboratory experiments, under controlled temperature and humidity conditions, on ovipositing females and the newly-hatched larvae.

²Assistant Entomologist, Division of Forest Insect Investigations, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

N. Y. Undoubtedly many stands some distance from the roads are infested, and it is also probable that further search will materially extend the southern and western limits. The spread of the infestation to the south will probably depend largely on the planted rather than on the natural stands, although there are extensive more or less isolated stands of native spruce in the mountains of North Carolina and Tennessee. Advices from the Canadian authorities indicate that a very large area on the northern shore of the Saint Lawrence River is infested, and recently an infestation was located at Lake Temiskaming, on the Ontario-Quebec line about 300 miles northwest of Ottawa. To the east at least two counties in Nova Scotia are infested.

The widespread occurrence of this insect indicates that it has probably been present in the northeast for several years. The heaviest infestations known at the present time in the United States are in plantations in western Connecticut and on the eastern slopes of the Adirondack Mountains. At the Macedonia Brook State Park, near Kent, Conn., Norway spruce trees were almost completely defoliated in 1934, and the attack in 1935 was heavy. At Tupper Lake, N. Y., considerable feeding occurred in 1935. The sawfly must have been present in the former area for at least 5 years and in the latter for at least 3 years.

All three native spruces—black spruce (*Picea mariana*), red spruce (*P. rubra*), and white spruce (*P. glauca*)—are attacked. In addition, individual and plantation trees of Norway spruce (*P. excelsa*) and white spruce commonly serve as hosts. In laboratory experiments the Colorado blue spruce has been fed on as readily as the other spruces, even by the young larvae, and on it larvae will complete their growth and spin cocoons. As a general rule the

larvae feed on the old needles, but after the needles of the current season mature particularly in the latter part of the season, these will be eaten as readily as the older ones. Heavy feeding gives a distinctly thin appearance to the crown. The characteristic feeding injury on the twig is shown in Figure 2.

Mr. R. E. Balch, of the Dominion Entomological Laboratory, Fredericton, N. B., reports that in the case of black spruce a green tuft is left at the top of the tree. He also states that in the forest a severe outbreak gives a grayish-brown cast to the stand. At the present time there are no known areas in the United States with an attack heavy enough to show this appearance, but even in light infestations feeding is heavier in the lower part of the crown. The early larval instars feed in two ways. Sometimes only a small piece is chewed off of the needle, whereas at other times these young larvae start feeding at the tip and work backward, eating all but the vascular bundle. In the older instars they feed from the tip, devouring the entire needle. The larvae feed singly at all times, and never gregariously as in the case with most sawflies.

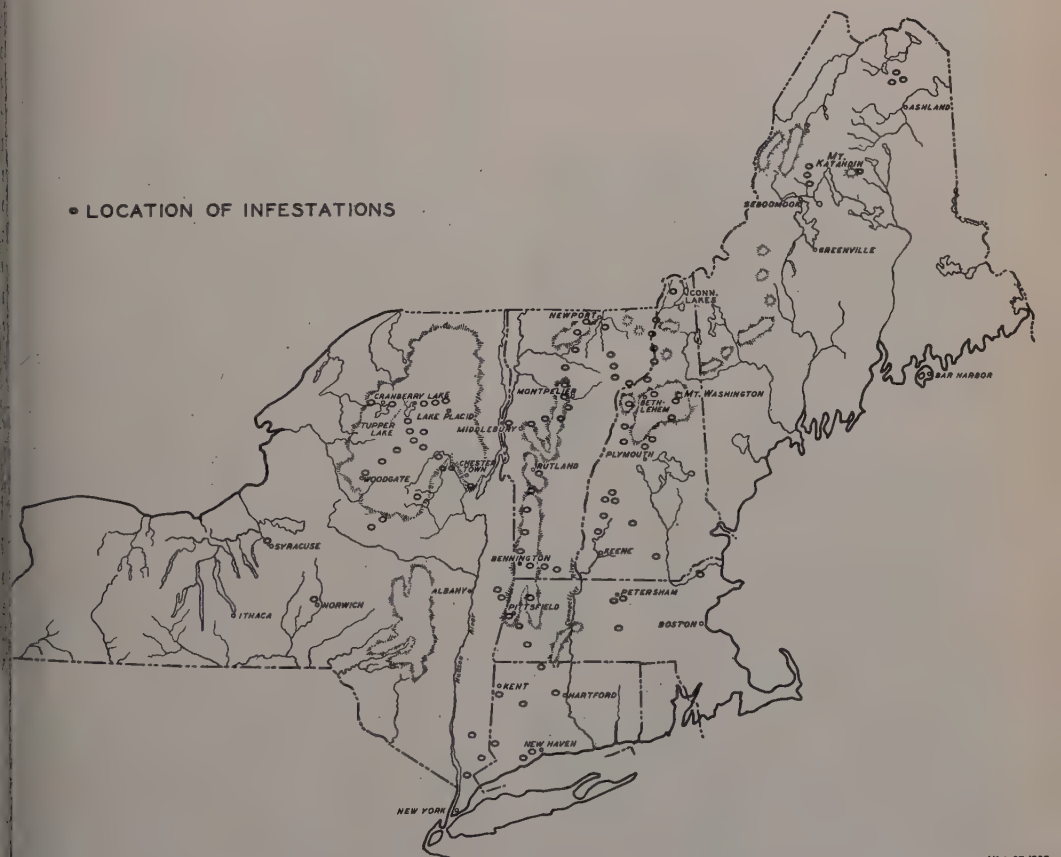
The adult of the European spruce sawfly has four wings, is rather stout and is black with yellowish markings on the abdomen, thorax, and front of the head. Males are rare and up to the present time none have been found in the United States. Reproduction is therefore parthenogenetic. The eggs, which are about 2 millimeters long, are laid singly in the needles. Balch states that they hatch (in the Gaspé region) about 10 days. Under controlled temperature and humidity conditions, in the Entomological laboratory of the Connecticut Agricultural Experiment Station at New Haven, eggs hatched in 5 days. The period of development under these conditions from egg laying to construc-

tion of the cocoon was 28 days.

The first- and second-instar larvae are almost the same length, averaging slightly over 3 millimeters, but the body in the second instar is thicker. The larvae gradually increase in length until in the latter part of the fifth instar they will average about 20 millimeters. They molt five times and in the last instar they become shorter and more robust. In the fourth and fifth instars five narrow longitudinal white lines are clearly discernible. These disappear in the sixth instar. This is a protective coloration, and in a light infestation it is difficult to see even the

larger larvae, and their presence can best be discovered by jarring the limbs and catching the larvae on a sheet spread under the tree.

The change to the adult takes place in a cocoon which is normally spun in the moss and litter above the mineral soil, very often almost at the surface. In this country the larvae of the summer generations may very rarely spin the cocoons on the twigs, as do those of the second generation in Europe. Balch has found that there is one generation in the Gaspe Peninsula and that there are two in New Brunswick. In northern Maine there prob-



Nov. 27, 1935.
H. J. Pelt. Albany - D. F. Bliss.

Fig. 1.—Known distribution of the European spruce sawfly in the Northeastern United States, November, 1935.

ably is one generation and in the rest of New England at least two. In the southern limit of the range there is evidence that there may be three generations, and when weather conditions are favorable there may even be a partial fourth generation. Large larvae were found at Orange, Conn., early in September, and larvae of all instars from early second to sixth were found in this same area the third week in October, and from first to fifth instars on November 19. Larvae of these same instars were also found at Tupper Lake, N. Y., at an elevation of 1,600 feet, on November 2, and at Macedonia Brook State Park in Connecticut, at an elevation of 700 feet, on November 8.

There may also be a long "holdover" in the cocoons, as is common with most

sawflies. In the Gaspé region these cocoons may hold over for 3 years before the adults emerge; no information on this holdover period is as yet available in this country. On the other hand it is known that the resting period may be very short. On October 21 one sixth instar larva was taken at Orange, Conn. Three days later this larva had spun its cocoon, and it emerged as a female sawfly on November 2. A living female was found in a plantation at Orange on November 1 and was observed laying an egg on November 3. Adult flies emerged from cocoons spun in the laboratory by larvae collected during August, September, October, and November from the Connecticut Lakes region and Lancaster, N. H., and from Tupper Lake, Norwich, and points in Westchester County and the Cranberry Lake region, New York. Adults from cocoons collected at Kent, Conn. were used by the Entomological Department at the Connecticut Agricultural Experiment Station in egg-laying experiments the results of which have already been stated. This indicates a very short resting period under favorable conditions and the possibility of more than two generations in the southern portion of the range. Very plausible evidence to indicate a third generation is that the feeding in two plantations on the New Haven watershed was definitely more noticeable in November than it was in September, and it was in one of these plantations that young larvae were collected on November 1 and again on November 19. Plans are being made to continue the study of the life history next spring and summer.

Methods for controlling this spruce sawfly cannot be positively formulated at this time. Prevention of damage by silvicultural practices does not appear promising. All sizes and ages of spruce are attacked, and natural and planted stands are equally susceptible. Individual specimen trees may be seriously damaged.



Fig. 2.—Injury by the spruce sawfly:—A, To the needles of the current season; B, to the old needles.

aged, as even a moderate defoliation will ruin their aesthetic value.

Reduction in numbers sufficient to keep the insect in check seems to be our best approach at present. It is believed that breeding and liberating large numbers of parasites before the insect has multiplied to such an extent that this measure will no longer be practical in saving the trees, may bring best results. The Canadian Government is already engaged in an extensive program of introduction of parasites from Europe. The Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, through cooperation with the Dominion Parasite Laboratory at Belleville, Ontario, has already liberated a colony of parasites of European origin in a sawfly infestation in northern Maine.

Parasites of other species of sawflies from the western part of the United States are being investigated with the hope that some species will be found which will attack *Diprion polytomum*. Some preliminary work has been undertaken in cooperation with the western laboratories of the Division of Forest Insects, which have furnished parasites of western sawflies for experimental study. Two colonies of parasites obtained from Oregon were liberated in western Connecticut during the past season, but it is not known whether they have become established. It is planned to continue these investigations on parasites in 1936. It is highly desirable to establish natural enemies in the Northeast before the sawfly has increased to such proportions as now exist in eastern Canada.

Predatory insects, such as the common soldier bugs, may prove to be of some value. It is already known that one of these, *Podisus maculiventris* Say, attacks the larvae and sucks their body juices. This is a very common species all over the northeastern region, and was observed attacking the larvae at several

points in New England during the past field season. Shrews and ground-feeding rodents account for considerable numbers of the cocoons in the litter, and there is evidence that the infestation at Macedonia Brook State Park has been considerably reduced by the activities of these animals.

Investigations for the insecticidal control of this sawfly on ornamentals and plantations are planned for the coming season. There is a heavy mortality of the early-stage larvae in laboratory experiments, and it is expected that this will also occur under natural conditions when climatic conditions are unfavorable. The mortality of larvae late in the fall will also be heavy, particularly under such circumstances as prevailed during October and November, 1935, in Connecticut. The weather was very warm, and undoubtedly there was a partial fourth generation. These small larvae will undoubtedly be killed, as they cannot possibly go through the entire larval development and spin their protecting cocoons before heavy frosts occur. Late-emerging females may lay eggs but, although these may hatch, they will not complete their development.

It is yet too early to predict what will be the result of the invasion of the insect into this country, but judging from conditions in eastern Canada the menace is a very serious one. However, the different conditions in our spruce regions may not prove so favorable for the insect. There can be no doubt that the situation calls for prompt and efficient action. Adequate surveys should be continued, and owners of spruce lands should watch their timber so as to take action if the defoliation becomes serious. Salvage operations may be necessary in some cases. Dusting or spraying experiments should be tried with the hope of holding down loss. It is hoped that the introduction and establishment of parasites may serve to keep down heavy infestations.

FEDERAL, STATE, AND PRIVATE COOPERATION IN A FORESTRY PROGRAM¹

By FRED W. MORRELL

U. S. Forest Service

ASIDE from the large benefits from protection against fire, the existing forest cover in the United States is, taken as a whole, very little different from what it would have been had there been no federal or state forestry organizations, no extension services, no forest schools, no research, and none of the other technical and administrative agencies that have been seeking over a third of a century to "solve America's forest problem."

In addition to their efforts in fire control, on both public and private land, public agencies have sought both through extension methods and direct financial aid to assist private timberland owners in control of insects and diseases, in silvicultural practices, utilization, planting, relief from tax burdens, marketing, and perhaps in some other ways. There have been some notable though relatively minor results in insect and disease control and planting, and some beneficial effects from the other efforts, but all added together they have had relatively small influence in the broad picture of national forest cover conditions.

Forestry in America has been in the past and will continue in future to be chiefly a question of private land management. The great bulk of the important timber-growing lands of the United States is still in private ownership. The federal holdings, although vast in extent, largely comprise the poor growing sites and less accessible areas. Any material advance in the practice of forestry must therefore still be concerned with these high-quality holdings now in private ownership. Wheth-

er or not, as many contend, public acquisition of the private lands is the best forestry program, all must realize the great improbability of getting sufficient public appropriations to purchase the major portion of these lands within the next several decades.

Less than 5 per cent of the timber cut during the last 20 years has come from publicly owned lands. This percentage will likely increase during the next 20 years, but there is no likelihood that it will for a long time amount to more than a minor percentage of the whole. Forestry practices have had relatively little effect on forest conditions in the past because of the small percentage of timber cut from publicly owned lands, where they have been applied, and because they have been applied to only a minor extent on private holdings, where most of the cutting has been done. This condition is likely to continue far beyond what might be indicated by the relative acreage of public vs. private ownership unless some way is found to get more general application of forestry practices to private holdings.

The importance of forestry on land in private ownership has, of course, been recognized by federal and state agencies since the initiation of forestry organizations in this country. An early expression along this line is found in the annual report of the Division of Forestry in 1899 which states that "since private forest lands exceed in area those of the federal government and the states combined, the preservation in productive condition is

¹Paper presented before the Association of State Foresters at Montpelier, Vt., October 15, 1920

ast importance to the Nation. Practical assistance will be given to the farmers, lumbermen and others in handling forest lands." The report then goes on to state that working plans with full directions for practical work will be prepared without cost for owners of tracts not exceeding 200 acres and for owners of large tracts who wish to cooperate by paying the cost of travel expenses and subsistence for the agents of the Division of Forestry while in the field, together with the necessary assistance, whom the owners must provide. Applications for assistance under this plan had been received covering nearly one million acres.

The making of working plans constituted one of the major activities of the new small Bureau of Forestry during the following decade, and in the report for the year 1906 it is stated that the total area of private forest lands in the management of which assistance had been asked totaled 11,717,269 acres.

Coincident with the federal government's plan to assist wood-lot and timberland owners by the making of management plans, it initiated a similar one for making planting plans, and the two activities were continued as direct federal government-private landowner cooperative effort until about 1910, when the projects were, in effect, closed out with the following comment:

"The obstacles to the practice of forestry by private owners are chiefly the danger from fire and the burden of a faulty system of forest taxation. Both lie within the field of state action; but the Forest Service stands ready to help the states in every way it can to work out a wise course of action."

While the federal service gave as reasons for dropping the work its National forest job, and the idea that private forestry was a state job, a more important reason may perhaps be found in the fol-

lowing statement from the Forester's Report for the year 1911:

"Past experience in examining woodlots and privately owned timber tracts has shown that methods of forestry recommended are actually put into effect in far too small a percentage of cases."

The exact extent to which the states were prepared to undertake this work in 1910 has not been determined, but it is certain that many if not all of them lacked authoritative legislation, appropriation, or organization, all of which are necessary for accomplishment.

By 1932, 34 states had provided by law for some measure of advice to owners of forest lands. Sixteen states reported that these laws were in some measure effective. In no case does the program affect more than a small percentage of the forest lands.

The last and major public effort to secure forestry practices on privately owned land was through Article X of the Lumber Code. The code arrangement amounted to a public sanction of industry agreement to control production, regulate wage rates and selling prices, and do other things calculated as necessary to protect the owner-operator against ruinous competition and otherwise enable him to proceed in an orderly manner to harvest his timber on a continuous production basis.

Any increase in cost of production due to the application of Article X would presumably be paid by the consumer-public in form of increased prices. The code arrangement is the only plan so far designed that contained real possibilities of wide range application. The public's share of the immediate cost of the venture was met by what amounted to a sales tax, no less real and no less burdensome than though by legislative appropriation. Had the code survived and public agencies been granted sufficient authority to enforce Article X's provisions, real prog-

ress in forestry might have been expected. But the early demise of the code puts us back where we were before its enactment, with protection as the only widely successful public effort to improve conditions on forest lands; and before considering other possibilities, it will be worth while to examine briefly the public effort in that activity.

During the decade 1925 to 1934 public expenditures in the name of forestry exceeded receipts by some 250 million dollars; of this amount 215 millions were expended on publicly owned property and 35 millions on privately owned. The expenditures came near to being in inverse ratio to our probable cut during the several decades immediately ahead; that is, the lands which receive 15 per cent of the appropriated funds will, or at least should, furnish 85 per cent of our wood supply; and for watershed protection, erosion control, game cover, and recreation they are at least of equal value.

Of the expenditures on publicly owned lands, it is difficult to estimate what may be properly charged against protection of grass and brush lands, administration costs for grazing, recreation, and other uses, and permanent capital investment that, once installed, may operate to decrease future costs. From available cost records it seems apparent that not less than 150 million dollars of the total should be charged against protection on the publicly owned lands, in comparison to 25 millions on the privately owned. The purpose of this comparison is not to criticise expenditures on publicly owned lands, but to point out that the public of the United States is apparently willing to provide the money needed for protection, and perhaps the money needed to insure continuous production (as indicated by the code arrangement) of our forest lands, if some plan mutually satisfactory to public and landowner can be evolved. That the public is willing to

underwrite protection in those parts of the country where the landowner is interested in the condition of his non-virgin forest lands is well demonstrated by the fact that out of 38 states now co-operating under the Clarke-McNary act, only 10 make protection contingent on direct contribution from landowners, and all of these are far western or southern states where the exploitation of virgin stands with consequent abrupt conversion from high value to extremely low value acreage is still in process.

Public effort without landowner and community interest may easily prove futile, but experience in extending protection has amply demonstrated that landowner and community interest readily follow public lead, and there is no serious question as to the feasibility of extending effective protection over the entire acreage of privately owned land if 20 per cent of current public expenditures for forestry were devoted to that purpose. Nor is there in my judgment any question that such an expenditure would bring larger returns to the public in terms of usable natural resources. The fact that \$33 stumpage is converted by industry into \$30 mill run products is sufficient proof of the public's interest in the natural resource regardless of who owns it. National wide protection has long been the first objective of the federal-state-private co-operative set-up. *It should be the first and most earnestly sought-for national objective in forestry.*

With the commendatory human desire to attain perfection in what we undertake, some foresters are inclined to overlook the principle that if 50 per cent or 75 per cent of a commodity desired can be bought with 25 cents, that represents a better investment than the buying of all of the desired commodity for a dollar. And, applying the principle to the subject under discussion, the expenditure of 10 million dollars annually for the protec-

tion of 400 million acres of land may buy more wood growth, more watershed protection, and more other social and economic advantages than will the expenditure of 10 million dollars for the protection and management of 100 million acres, even though on the latter that desideratum of foresters, sustained yield management, may be attained, and on the former only a partially stocked but continuously growing forest. Given adequate protection both before and after cutting, we shall as a very general rule have forests, though lower in quality and productive capacity than if managed under approved forestry practices. We have not yet accomplished protection over a large percentage of our most productive forest lands, and further progress in forestry must still largely be made on these same lands; and if improved forest practices should become a reality on most of these lands, it will be with them still in private ownership. The public is not going to buy a large percentage of them, and any forest policy that is not concerned chiefly with them is a minor policy.

Past public effort to encourage forestry on private land has so far largely failed because inducements offered were not attractive to landowners. A larger measure of public participation is evidently necessary if future effort is to be more successful.

It is generally recognized that one of the greatest obstacles to sustained yield forestry by private owners is the large investment, with consequent carrying charges, in forest land. These investment and carrying charges are not escaped through the process of transferring the land to public ownership. Federal and state governments are like most private industry borrowers, though at a lower rate of interest. If the property is not managed as to return capital investment, maintenance, and interest, then the public goes without direct financial re-

turns no less really than does the private investor. And if public property does not pay taxes, then government forgoes tax income just as really as it does when private owners do not pay.

Few foresters would argue against the probability of the public forgoing a large part of these returns when it embarks on the prospect of forest land ownership and management. The purpose of the undertaking is of course not to make money but to accomplish the social and economic advantages of forest management. We are now in a greatly expanded federal acquisition program and endeavoring to start a greatly expanded state program. The advantages of public ownership can be greatly enhanced if the public land can be managed in conjunction with an equal or larger area of private land under agreement that the whole shall constitute a cooperative working circle for sustained production.

In the location of acquisition areas under the Fulmer act the possibilities of such an arrangement should in my judgment be consideration Number One. Personally I do not favor the acquisition of large blocks of land sufficient to maintain within themselves large-scale sustained yield operations, or the building of Chinese walls around these areas in the shelter of which to practice book forestry and from the top to yell "devastation" across the vast intervening spaces. If this practice is followed, all of the forestry that we can even hope to practice under the Fulmer act will be of relatively small consequence. To the extent that the areas can be used as a center of influence over a wider territory, more will be accomplished.

Let us recall the statement that publicly owned forests are ventures on which to spend, not to make money, and let us face the undeniable fact that public management is on the whole far less eco-

nomical than private management. Let us also face a further fact that it has not yet been demonstrated that public forestry agencies will be permitted to manage large areas of forest land the products of which are in strong demand, in just the way they would like. The small cut from the large volume of publicly owned timber in the West is evidence that there has been little demand for it, and the acquisition areas in the East, both federal and state, have so far grown very little merchantable timber. Public forest management has not yet faced the test of strong industrial demand, yet we are not without some instances of management plans yielding to local or group pressure, and in the management of range lands, which have been in demand, we are faced with many instances of inability to overcome the same economic self interest pressure to which private management is subject or to prevent the use of a publicly owned resource for much less than its market value.

It is not intended to condemn or criticize public management, only to point out that while public management may be less affected than private management by economic and selfish demands, it is not by any means free of these influences. It is possible that fair and workable cooperative management agreements that could not be abrogated without violation of contractual obligation might strengthen rather than weaken public land management plans.

While many people who have studied the question believe that cooperative management would greatly extend the influence of public ownership, there may be serious question as to the extent that it is workable unless the public contributes more than the investment and carrying charges on its own land. Obviously private and public owner should be under the same tax system for support of local government, and be able to finance at a

comparable interest rate; and that call for the extension of public credits.

But since there is every evidence that aside from interest and tax charges publicly owned forest property will be far in the red so far as direct money returns are concerned, it should not be assumed that the private owner can, if given these same advantages, make a profit. And without chance of profit, private capital will not, of course, invest. Management plans for all publicly owned forests call for the expenditure of funds for installation of protection, marketing and administration facilities, planting, and stand improvement, relatively large in comparison with current sale value of the property. It would be a rash forester who would predict that the money income will ever be sufficient to return these investments with accrued interest and current carrying charges. The extension of some of such assistance to privately owned forests without expectation of reimbursement would not, therefore, be inconsistent, provided it resulted in an improved management in ratio to the investment made.

Many foresters have condemned and will no doubt continue to condemn such a proposal on the ground that there is no way by which public equities can be protected against selfish private interests. But the very essence of public land management is an assumption of the public's ability to enforce its contracts, and so far as actual contractual agreements are concerned forestry agencies have pretty well demonstrated that ability. It must be remembered, of course, that it is one thing to enforce a contract which an individual enters into willingly in the expectation of reasonable returns, and quite another to enforce on him a system of land management which he did not devise, and which he does not regard as being in his business interest.

It is not my purpose to discuss here the exact forms of possible contractual agree-

ments, even if time afforded. Before any forester in public service attempts to do that he should first select a representative area of forest land and figure out what he as landowner-investor would want in such agreements before undertaking a forest management project because if he could not get the minimum of support from his public partners he would of

course not enter into the undertaking.

Four-fifths of our productive forest lands are still in private ownership and the major part of America's forestry is concerned with them. Federal-state-private effort is the only method of management applicable to them. Let us not forget that point, on the eve of what we believe may be a greatly expanded state program.



MINNESOTA FIRE CLAIMS CASES

CONGRESS in the last session appropriated \$10,000,000 to compensate claimants for losses incurred in the great fire of 1918 in the vicinity of Duluth. These claims had been tried and adjudicated by the courts and settlement made on a basis of about 50 per cent of the damages claimed. The action of Congress sets aside this court procedure and substitutes political pressure as a means of collection. The measure called forth a vigorous denunciation from David Lawrence, nationally known editor in the *United States News*.

Those familiar with the situation felt that most of these claims were exaggerated, as so often happens in damage suits, and that the federal control of railways during the War was seized on as a pretext for endeavoring, successfully, to collect very large damages for fires, some of which at least were probably not started by the railroads at all. The brief period of government operation of these roads was sufficient to remove all safeguards against the operation of such claims, which unless properly adjudicated would bankrupt any ordinary private business.

H. H. CHAPMAN,
Yale School of Forestry.

PROFESSIONAL HONESTY AS REGARDS SELECTIVE LOGGING

By RALPH C. HAWLEY

Yale University

DURING the last few years a great deal of attention has been given both in forestry and industrial circles to the subject of selective or partial cutting of forest stands. It is hardly necessary to define for the readers of this JOURNAL what is meant by the term "selective logging" or "partial cutting," since this side of the matter already has been covered by other writers.

The late W. W. Ashe was among the first to place emphasis on the fact that often there is no profit, but instead a loss, in cutting small trees even though of size to give merchantable products. He pioneered in the field and did much to bring out the importance of this subject. The idea in itself could scarcely be called new to professional foresters, since the whole theory of raising forest crops presupposes growing them for utilization at the most profitable sizes. It might then be considered unnecessary to stress the fact that trees should not be cut until they have attained that desirable, profitable size.

However, foresters quickly recognized the value of Ashe's presentation of the idea as an aid in introducing private landowners to the whole subject of forestry. It was an entering wedge, with great advertising and selling value for influencing private landowners to give consideration to forest crop production, or at least to stop their current methods of devastating the forests which they operated. Hence it is not surprising that there has been a movement all over the country aimed at showing the boundary line between trees of profitable versus unprofitable size for cutting, and explaining the financial advantages which may

accrue when unprofitable trees are left in the woods.

The development of this idea and the bringing of it into practice in the forest justifies further advertisement. However, in the effort to take advantage of partial cutting and selective logging as a basis for leading private owners into the practice of forestry, professional foresters have in some instances attempted to extend this style of cutting to situations outside its legitimate range. It has in some cases amounted almost to a deification of partial as contrasted to complete cutting of the stand. From the biological standpoint it may be true in many, though certainly not in all cases, that partial cutting is superior to clear cutting; yet from the practical standpoint of securing a specific crop, there will be instances where the clear cutting method better suits the requirement of the forest manager.

Selective logging is not suited to all forest species, nor to all situations (natural and economic). From the ecological standpoint, there are so many factors to be considered as to make it obvious that any one system of cutting cannot be made to fit all conditions.

The essential idea of selective logging, namely, that only profitable trees (usually trees of the larger size or better quality classes) will be cut, works out in the field, when skillfully applied over a considerable period of time such as a forest rotation, in one of three ways:—

a.—As the result of the selective logging or partial cutting, trees of several age classes intermingled are established and maintained on the same area. This is unevenaged arrangement and permits of successive cuttings over the whole area at intervals.

b.—The profitable trees occur and are removed in solid blocks or groups, and these may be interspersed by blocks of less profitable trees (younger or of inferior species or quality) which are left uncut. Here is seen a forest containing evenaged stands of a variety of age classes. The idea of cutting only profitable trees is followed out because only the old age class with the biggest and best timber is harvested.

c.—The selective logging or partial cutting becomes a continuous tending of single trees over the whole area. This resolves itself into a light cutting in each stand at intervals only a few years apart, removing each time a few of the biggest or most profitable trees. Such a method of cutting may tend either toward the maintenance of a fairly regular two-storied arrangement of the trees in the stand, or may tend toward a many-aged arrangement. In either case partial cuttings of this type are extremely intensive and have as a counterpart the European technique known as "Dauerwaldwirtschaft," "Einzelstammwirtschaft," etc.

Undoubtedly some of the writing on the subject of selective logging in this country has obtained its inspiration from consideration of these very intensive European types of cuttings. They represent high utilization of site from the production standpoint, but require conditions permitting intensive management for realization of the high production potentially incident to the method. Forest conditions in this country have not as yet reached the stage where application of such intensive management is generally practicable or, in many cases, silviculturally best.

Some of the advocates of selective logging and partial cutting, carried away by the theoretical idealism of the concept, have overlooked the fact that such meth-

ods work best in pure stands under biological conditions which prevent a change from one forest type to another almost irrespective of the style of cutting. The ponderosa pine type may be taken as an illustration of this point. Because of the inability of other species to grow under the site conditions characteristic of the ponderosa pine type, there is no danger of these areas being seized by other tree species as a result of cutting. If a forest cover is maintained at all, it will be ponderosa pine, and hence whether the cutting is clear cutting or the lightest type of partial cutting means little from the standpoint of change of type. On the other hand, stands of northern white pine in the northeastern United States, if managed on a system of selective logging over a single rotation, are likely to be replaced by other species of greater tolerance and of more mesophytic habit.

There are undoubtedly many forest types in the country where selective logging or partial cuttings of the character listed under headings *a* and *c* will fail to maintain a forest crop similar to the one harvested. In some cases such a consequence may be just what is wanted, but in many cases a crop of the same tree as is harvested may be desired. Where maintenance of the climax forest is the aim in forest management, selective logging is more likely to react favorably than where a temporary type is the preferred forest crop.

Consider the Douglas fir forest in the Pacific Northwest. These stands may be pure, or may contain considerable mixtures of such associates as western hemlock, Sitka spruce, lowland fir, and Arbovitae,—all more tolerant than the Douglas fir. Even where the Douglas fir is practically pure, an understory of these species is likely to develop as time passes. Emphasis today is being placed on the possibility of going into these stands, which range from 150 to 800 years of age, with more flexible types of equipment

than have been used in the past, enabling selection of certain trees and the leaving of the balance of the stand instead of the customary extensive clear cuttings.

Selective logging in these stands of course removes the most profitable trees, which means the best Douglas fir and more valuable timber such as Sitka spruce and Arborvitae, leaving defective individuals of all species and sound trees of the less valuable hemlock and lowland fir, together with small trees of all species.

This is a radical change as contrasted to the old method of operating and character of cut, and is likely to be significant in its results. To the operator it brings a better financial return and may enable him later to introduce conservative practices in the woods, to carry his present investment and eventually turn his operation over into one of sustained yield management. However, from the standpoint of the succeeding crop of timber which is likely to follow, the results may be unfavorable. Possibly the defective individuals and the trees of the least valuable species may extend their crowns over a large share of the area, and hold the ground against the better species. The abundant supplies of seed produced by the inferior species and the ability of these species to reproduce under the conditions of light cutting, may result in a much smaller representation of good species in the new crop than existed in the stand before initiation of selective log-

ging. Consequently the result of the partial cutting in this case may be future crops of poorer quality. This calls attention to the fact that the practice of good silviculture, particularly in mixed stands, demands the cutting of many unprofitable trees. Selective logging and partial cuttings of profitable trees will only accidentally and in occasional cases prove successful in establishing good crops of timber.

The purpose of this article is not to discredit or to discourage the use of partial cutting and selective logging where applicable, but rather to protest against accepting these as universally approved methods of harvesting timber.

Let us as professional foresters work with our eyes open, not blinded by any one theoretical concept which may be good so far as it goes but which common sense tells us cannot be equally good everywhere and may not cover the whole subject. Let us on the other hand envision the future results of any partial cutting which we contemplate, and weigh the advantages and disadvantages, not only on the basis of the immediate financial profit of the operation, but also upon its ultimate consequences. Use the propaganda value of selective logging for all it is worth, but be honest with yourself and do not be led into thinking that partial cutting or selective logging is a panacea which will solve all the problems of silviculture.

PAINTED NUMBERS ON TREES IN PERMANENT SAMPLE PLOTS

By ROBERT T. CLAPP
Yale School of Forestry

DISADVANTAGES in the use of metal-tag numbers nailed to trees on permanent sample plots are leading to renewed use of painted numbers. The permanence of the metal tags as contrasted with figures which have to be repainted may be outweighed by injury to the trees by the nails, the impossibility of reading the tag numbers from a distance, and other factors. The advantages and disadvantages of the tag and paint methods are set forth by Morey and Stickel in a recent article¹ which describes in detail a method of applying the paint by means of rubber-stamp numerals.

The use of this stamping outfit in the Eli Whitney Forest gave an opportunity in the fall of 1934 to test the relative costs of stamping the numbers on the trees and of painting them free-hand.

On one plot comprising 3 $\frac{3}{8}$ acres of Connecticut upland hardwoods between 60 and 80 years of age, with an understory of hardwood reproduction 1 to 20 years old, 543 trees were marked, including 16 species and with a diameter range of 2 to 17 inches. The plot was divided into 15 sections, 7 of which were treated by the free-hand method and 8 by the stamping method.

The time required for each step of the work on this plot, by each method, expressed in minutes per tree, including all species and diameters, is given in Table I derived from the field data.

The preparation of the bark consists of scraping it with a stiff wire brush or a draw knife until smooth enough for application of the paint. Less time is re-

quired for this in the free-hand method because it is not necessary to have so smooth a surface as in the stamping method. The bark of many trees, especially the younger ones, does not need any smoothing at all.

In this experiment the free-hand painting of the number took a little longer than the stamping. The time spent in painting a number free-hand might vary greatly, depending upon the skill of the painter and the quality of result desired. In this case all that was required was that the number be legible and reasonably well shaped.

TABLE 1

	Free-hand method	Stamping method
Preparing bark	0.6	0.8
Painting or stamping numbers	1.9	1.7
Retouching numbers	—	0.8
Painting breast-high dots	0.7	0.7
Total	3.2	4.0

(To obtain these figures the work was separated into the steps listed, each step being completed on one section of the plot before starting the next step. The time per tree can be lowered in practice by combining steps and using a crew of two or three men.)

In the stamping method it is necessary to retouch the numbers with a paint brush to correct irregularities in the shape of the figure due to the roughness of the bark, and to fill in portions where the stamp frequently leaves only a faint imprint. If done after the first coat has

¹Morey, H. F., and P. W. Stickel. Numbering trees on permanent sample plots with rubber stamps and paint. *Jour. For.* 33: 422-425. 1935.

dried, the retouching adds a second coat of paint. The brightness of the figures when examined 10 months after painting indicated that when the whole number is thus gone over, it is likely to last considerably longer, but in that case the stamp serves chiefly as a guide in forming a perfect figure, most of the paint being applied to the stamped pattern later with a brush. Possibly some other type of guide, such as a stencil, would produce the same result without the necessity of retouching.

On this plot most of the stamped numbers were touched up just enough to perfect the outline of the figure. The table shows that this step caused the stamping method to be about 25 per cent slower than the free-hand method. To go completely over each figure with the brush would have more than doubled the retouching time. Whether the added expenditure of time is worth while or not depends upon the life of the number and the amount of time required for renewing it in later years.

In addition to the factors listed, the stamping method requires more time for cleaning the equipment at the end of the day, and the cost of the equipment is of course higher.

The choice of methods depends largely upon the desired appearance of the plots. The stamping method certainly produces more artistic results in the form of very neat numbers of uniform size and shape, but legible numbers satisfactory for purely technical purposes can be produced cheaper by free-hand painting. The relative costs of maintaining the numbers cannot be determined at present.

An interesting side issue of this experiment was the determination of the time required for removing the tags and nails with which the trees had previously been numbered. Drawing out the nails is a necessary procedure every few years in sample plots where metal tags are used; otherwise the nails and tags soon become imbedded in the trees. The time for removing the tags, without renailing them, averaged 0.27 minutes per tree.

A PAINT SPRAY OUTFIT FOR NUMBERING TREES

By RALPH C. HALL¹

CHOOSING a satisfactory method of identifying trees on permanent sample plots in forestry work usually presents a problem. In general, there are three methods of identification: (1) By the use of metal tags, either nailed to the tree or fastened by wire; (2) by the use of painted numbers; and (3) by the use of a stem map. There are certain advantages in each of these, depending upon the size and arrangement of the trees and upon the length of time that the experiment is to run. In sample plots established in plantations of uniform spacing a stem map is a convenient and satisfactory method, provided a permanent starting point is established and tied so that it can be relocated at any time. However, in stands of varied spacing where trees are not in rows, the stem map is not so convenient and is ordinarily used only to supplement some method of actual tree numbering.

There appears to be considerable controversy among foresters as to the relative merits of metal tags and painted numbers. Morey and Stickel (3) have very ably summed up the advantages and disadvantages of each. Although their discussion deals with stamped numbers, using paint, it applies equally well to any painted numbers. There is one disadvantage of metal tags which they did not mention at which may be important in certain cases—their destruction by squirrels. Kuenzel, in 1935, reported such destruction on permanent sample plots in Indiana, where on certain sample plots every tag had been destroyed. L. I. Barrett, of the Appalachian Forest Experiment Station, reports similar destruction of tags in North Carolina and Georgia.

In many instances it is advisable or necessary to use painted numbers rather than metal tags. There are, in general, four methods of applying painted numbers to trees: (1) by hand lettering with a brush; (2) by the use of rubber stamps as suggested by Berg (1) and further recommended by Morey and Stickel (3); (3) by the use of stencils; and (4) by the use of a spray gun. With the first three methods it is necessary to smooth the bark, except on small, smooth barked trees, prior to the application of the painted number, and this tends to increase the cost. It is the fourth method, the use of a paint spray outfit, with which this paper deals.

The apparatus consists of a portable paint spray gun which is operated by compressed air or gas. Pressure for the gun is supplied from a portable 10-gallon metal tank to which is attached a 25-foot length of air hose to permit the marking of a considerable number of trees without moving the pressure tank. Pressure in the tank is produced either chemically or by hand. The paint spray from the gun is forced into all cracks and crevices in the bark, and a continuous, clear, durable number can be placed even on extremely rough bark.

With this outfit it is possible to number trees as small as one-half inch (d.b.h.) by the proper regulation of the width of the paint spray ribbon. It is a comparatively rapid method of tree numbering, since one man can number and place a dot at breast height on from 60 to 100 trees per hour, depending upon the size and distribution of the trees. The outfit herein described has been used to number over 7,000 trees on permanent sample

¹Assistant Entomologist, Bureau of Entomology and Plant Quarantine in cooperation with Central States Forest Experiment Station, Columbus, Ohio.

plots for the study of the locust borer during the past two field seasons, and has proved very satisfactory. Figure 1 illustrates the way the numbers appear on trees of various sizes. The largest tree section in the group illustrated is 5 inches in diameter and the smallest is one-half inch. Trees as large as 36 inches in diameter have been numbered with this outfit. All pieces in the illustration are from black locust, and all but the four smallest specimens have serious locust borer damage, which makes numbering other than with a paint spray very difficult.

In addition to being a comparatively rapid method of tree numbering, this outfit is economical in operation. One quart of paint is sufficient to number about 1,000 trees. The amount of paint required varies according to the diameter

of the tree and the character of the bark.

NUMBERING PROCEDURE

The spray gun is held in the hand and is operated by pressing the air release button on the gun. This starts the spray ribbon, and by moving the hand as in numbering with a brush any desired number or letter may be formed. Anyone with a reasonably steady hand can form legible numbers or letters with this outfit. The nozzle of the gun should be held from 1 to 2 inches from the bark while the number is being formed. The width of the spray ribbon can be regulated by screwing the gun nozzle in or out as desired. For small trees a width of about one-quarter inch appears to be satisfactory, while for larger trees three-quarters of an inch or wider may be used.



Fig. 1.—Spray equipment (including pressure tank, pump, and spray gun) used in numbering trees; and sections of trees numbered with this outfit. The section on the extreme left is 5 inches in diameter and the one on the extreme right is one-half inch.

KIND OF PAINT TO USE

A number of different paints and enamels have been used in experimenting with the outfit, and it now appears that flat, outside-white paint is the most satisfactory of all those tested. Enamels work quite satisfactorily but tend to vaporize more than the flat white paint; in addition, the numbers formed from enamels are more likely to flake off. The paint could be thinned to a consistency that will pour readily (just a little thinner than would be used with a brush). All paint should be strained through a fine-mesh wire screen before it is put in the paint mason jar, to make sure that it contains no solid particles that might plug the gun.

METHODS OF PRODUCING PRESSURE

With the outfit described herein it is possible to compress air with a large automobile pump, as is shown in Figure 2, or to produce gas pressure by the use of a chemical. If air is compressed by hand, it appears more efficient to use a two-man crew, one man to operate the pump and carry the tank and the other to operate the gun and number the trees. When air is compressed by hand the rate of producing numbers is reduced by almost one half. If pressure is produced chemically the numbering can be satisfactorily done by one man. The most satisfactory chemical for the development of gas pressure proved to be carbon dioxide in either the solid or the liquid form. The principle involved in the development of gas pressure with carbon dioxide is as follows: Carbon dioxide is reduced to a liquid or solid under great pressure, and the pressure is released when it returns to a gaseous state. If the solid form is used, it is necessary to have a fairly large inlet valve in the pressure tank. A standard 3-inch inlet valve was welded into one end of the

pressure tank to permit the insertion of large pieces of solid carbon dioxide. Solid carbon dioxide is usually sold under the common name of dry ice and is generally available in most towns or cities. Dry ice is relatively inexpensive, costing only about 8 cents per pound, retail. With a 10-gallon capacity pressure tank, 1 pound of dry ice will produce sufficient pressure to number about 100 trees. The chief disadvantage of dry ice is that it is relatively unstable and must be stored in a tight refrigerator box to prevent melting. A cheap but effective box for this purpose is pictured in Figure 2.

Liquid carbon dioxide can also be used to produce gas pressure, and in many ways it is superior to the solid form. Its chief advantage is that it is sold in 20 or 50 pound lots in strong metal tanks, and in these tanks it is much more easily transported or stored without loss through evaporation. Another advantage is that the pressure tank can be filled more quickly and with less trouble with the liquid form. If the liquid carbon dioxide is used, the pressure tank should be equipped with an ordinary tire valve. Then, by attaching a short length of good-quality air hose, with an air chuck attachment, to the outlet valve on the carbon dioxide tank, the expanding carbon dioxide can be drawn directly into the pressure tank. Figure 3 illustrates the method of filling the working pressure tank from the carbon dioxide tank. It requires about 5 minutes to fill the working tank to its capacity of 150 pounds. After the working tank is filled the air chuck can be disconnected, and the outfit is then ready for use in the field. Figure 3 also shows, diagrammatically, the position of the valves and other items of equipment used in tree numbering.

(*Caution:* Do not put dry ice or any other chemical for developing pressure in a tank unless it has a safety pop valve that will release the pressure if it approaches the capacity of the tank.)

EQUIPMENT

The equipment used in connection with developing a working pressure and actual tree numbering is shown in Figures 1, 2, and 3. This includes the following:

Spray gun.—The most suitable type of spray gun for tree numbering appears to be one which can be attached to a pint mason jar. It should be equipped with an adjustable nozzle for regulating the width of the paint spray, and also a thumb or trigger release for starting and stopping the spray. See Figure 3, *m*, *p*, and *q*. A simple improvement was made by substituting a sponge rubber washer under the thumb release for the metal spring; thereby effecting a considerable saving of pressure. See Figure 3, *n*.

Pressure tank.—The tank used in this work was a well constructed metal tank weighing about 40 pounds, built to withstand up to 150 pounds of pressure. Its

capacity was about 10 gallons, and it was fitted with a special 3-inch inlet valve for the insertion of dry ice. See Figures *j* and *k*. This tank had the following equipment:

Pressure gauges: Two pressure gauges were used, one to indicate the pressure in the tank and the other to indicate pressure on the air line to the gun. See Figure 3, *f* and *h*; also Figure 2.

Safety pop valve: All pressure tanks should be equipped with a safety pop valve to relieve the pressure before it approaches the capacity of the tank. See Figure 3, *e*; also Figure 2.

Pressure regulator: A pressure regulator is essential if pressure is developed with chemicals or if the amount of pressure in the tank at any time exceeds the working capacity of the gun. It develops that the most efficient working pressure for the gun was about 15 pounds, and by means of this regulator the pressure

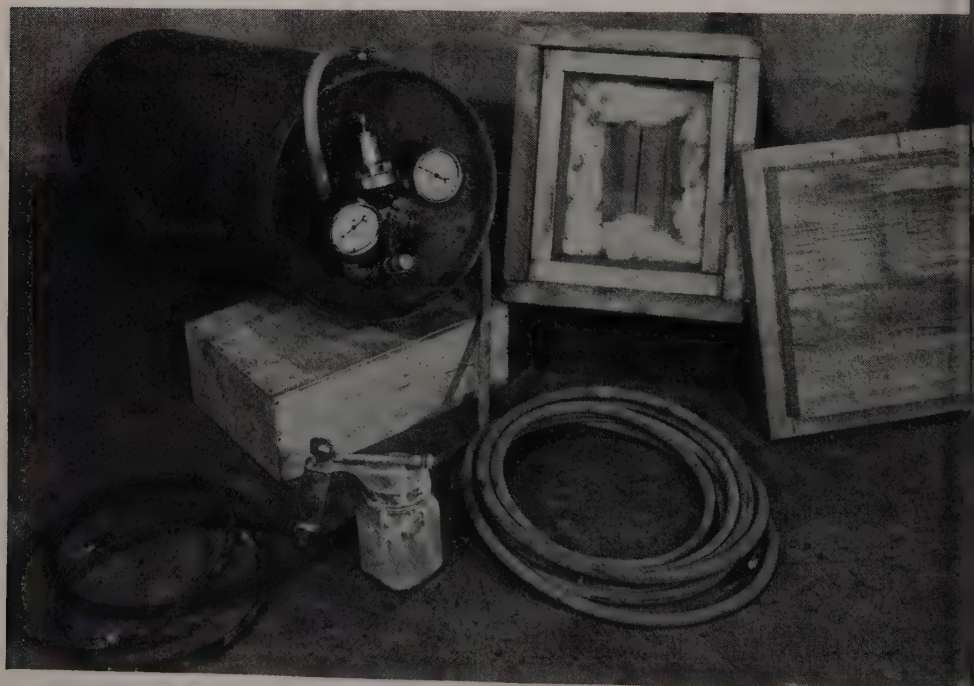


Fig. 2.—Spray outfit for tree numbering, with pressure tank and equipment, spray gun, refrigerator box for storing dry ice.

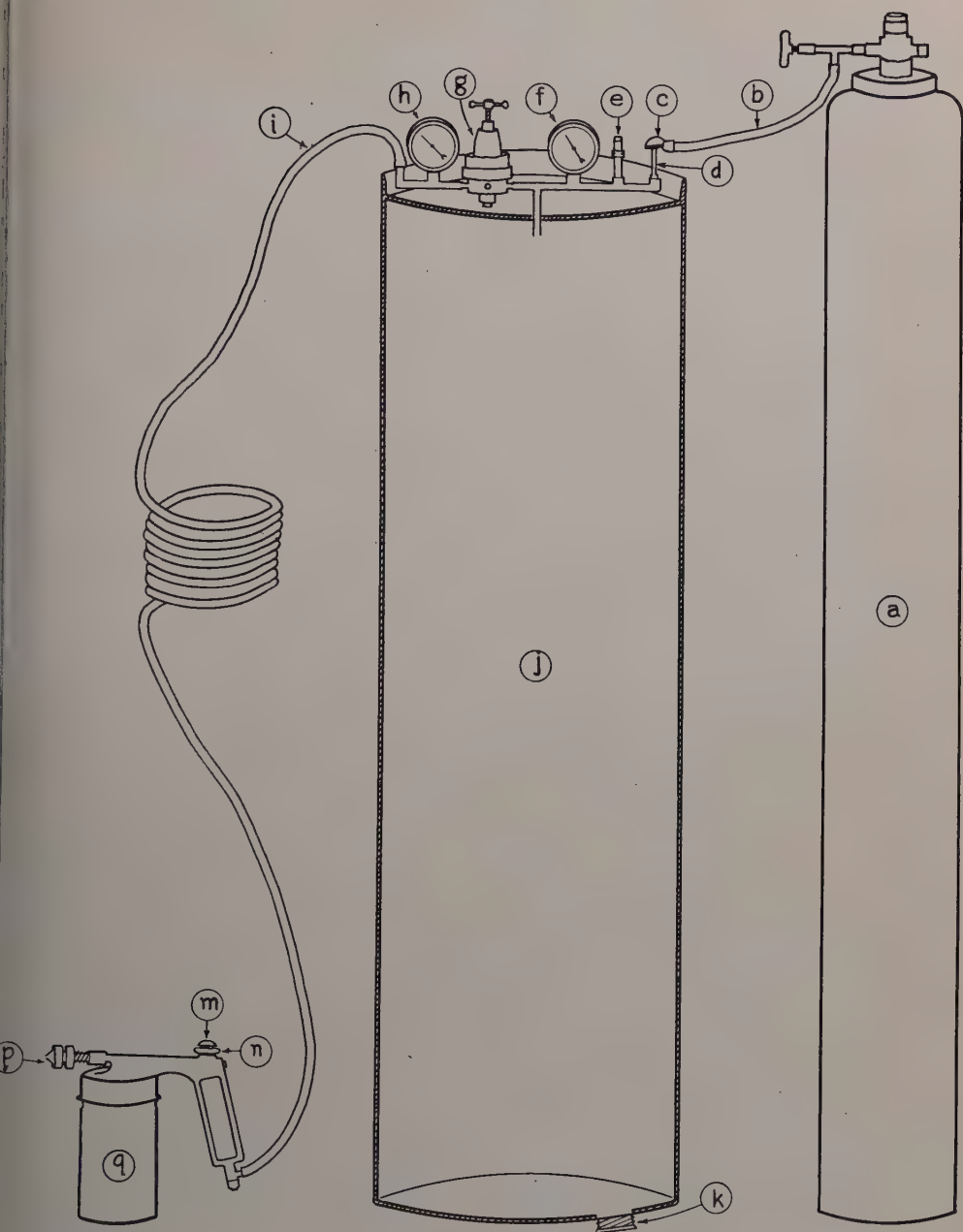


Fig. 3.—Diagrammatic sketch of paint spray outfit: *a*, liquid carbon dioxide tank; *b*, air hose; *c*, air chuck; *d*, valve stem; *e*, safety pop valve; *f*, gauge to show pressure in tank; *g*, pressure regulator to maintain constant pressure on gun; *h*, gauge to show pressure on gun; *i*, air hose; *j*, metal air tank; *k*, valve for insertion of dry ice; *m*, thumb air release; *n*, sponge rubber washer; *p*, adjustable spray nozzle; *q*, pint glass mason jar.

the gun may be made constant irrespective of the pressure in the tank. This regulator is shown in the top center of Figure 2 and at *g* in Figure 3. If air is compressed by hand as the painting is done, this regulator could be dispensed with, but care should be exercised to see that the pressure in the tank does not exceed 30 pounds. A pressure greater than 30 pounds on the gun is likely to crack the glass mason jar.

Air valve: An ordinary automobile-tire valve stem was fitted to the tank to permit filling the tank by means of a tire pump or from the liquid carbon dioxide tank. It also permits the filling of the tank with air at a gasoline filling station. The valve is illustrated in Figure 2 and at *d* in Figure 3.

Inlet valve: A 3-inch inlet valve was welded into one end of the tank to permit the insertion of dry ice or other chemical. See Figure 1 (at top of tank) and Figure 3, *k*.

Tire pump.—A large-size tire pump was used to develop air pressure in the field in the absence of chemicals. (Figure 1.) This equipment is optional if pressure is to be developed by chemicals.

Rubber air hose.—A good grade of air hose 25 feet in length was used with this outfit. The length of the hose is optional. If the 25-foot length is used, a sample plot of one-tenth acre can be numbered by moving the tank only four or five times.

Refrigerator box.—If dry ice is to be used for developing pressure, a refrigerator box is essential to prevent loss through evaporation.

The total cost of the above equipment

was \$41.50, and the weight was about 100 pounds. The depreciation on this outfit should be small. Over 7,000 trees have been numbered with this equipment to date without any expense except for chemicals and paint.

CONCLUSION

The chief advantage of the paint-spray method for numbering trees over other methods of paint application lies in the fact that no preparation of the bark is necessary prior to numbering, because the paint spray is forced into all cracks and crevices, and a continuous, clear, durable number can be made even on very rough-barked trees.

The chief disadvantage is the weight and bulk of the equipment; however, by using a sufficient length of hose, the tank can be set in one place and all trees within the radius of the length of hose can be numbered before it is necessary to move the tank.

Through the continued use of this and a similar apparatus, further improvement may be expected.

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THE EFFECT OF STEAMING ON THE DURABILITY OF UNSEASONED SAP-GUM LUMBER

By T. C. SCHEFFER AND R. M. LINDGREN

U. S. Bureau of Plant Industry

SOUTHERN hardwood operators commonly employ a steam treatment as a preliminary procedure to the air-seasoning of sap-gum lumber (from sapwood of *Liquidambar styraciflua*). Following this, the lumber is cooled in the open and then placed in air-seasoning piles on the yard. This treatment, when properly executed throughout, hastens surface drying of the lumber and thereby reduces the hazard of such fungus defects as stains, molds, and decay, to which sapwood is susceptible during the earlier stages of air-seasoning. Additional advantages of steaming are that it imparts a desired reddish color to the stock, and avoids largely such distortions often result from the end-racking method of seasoning. The usefulness of steam treatments which are followed by proper handling of the lumber has been demonstrated by practical field tests of 4- and 8-hour steaming periods at 180° F. (4).

The steaming practices in use at different mills vary considerably; temperatures range from 150° to 190° F., and the periods from 6 to 35 hours. The methods of handling the stock after it leaves the steam box and of piling it on the yard differ also. Failure to obtain the expected results from the treatment is usually traceable to faulty steaming, and particularly to improper subsequent handling of the stock. However, there is a belief among some mill operators and wood-users that steamed stock under certain conditions is more susceptible to fungus attack during seasoning than unsteamed stock. The basis for this opinion is to be found in the periodic occurrence

on steamed lumber of white decayed areas, known as "dote-spots," together with large areas of a salmon-colored mold. These particular defects are seldom found on unsteamed material at the same mills. It is fairly well established that heat treatments, especially wet heat treatments, of wood may cause physical and chemical changes in varying degrees, depending upon the severity of the treatment (2). The biological significance of such changes within the wood is not yet known, although scattered reports indicate that changes in durability may result from comparatively mild heating (1,3). It was with the purpose of determining whether the steaming practices in use at some mills lowered the durability of lumber during air-seasoning that the experiments reported herein were conducted.

EXPERIMENTAL PROCEDURE

Two similar series of experiments were run, each using freshly cut sap-gum lumber from different trees and involving steaming at different times. The boards were placed with regular charges of sap-gum lumber at a mill where steaming was carried out, thus obtaining material which was representative of the commercially steamed product at this mill. In both series a 6/4" x 8" x 4' board was sawed across into two pieces of equal size; one of the halves being steamed and the other serving as control material. The steaming temperatures were below those employed in the major portion of southern steam-box operations; however, the periods of steaming were longer. The

material for Series A was steamed for 33 hours at an average temperature of 155 degrees F., and that for Series B for 33 hours at an average temperature of 165 degrees F. Approximately 4 hours elapsed before the temperatures reached a generally constant value, which was maintained over the remainder of the steaming schedules.

Preparatory to inoculation both the steamed and unheated boards (which came from the same annual rings and were vertically adjacent) were machine-sawed into test pieces 3" x 1½" x 1½" in size, which were then numbered. Alternate test pieces were reserved for moisture determinations and for the calculation of the oven-dry weights of the pieces to be inoculated. Since the purpose of the study was to determine heat effect, original oven-dry weights of the test blocks could not be measured directly; but through micrometer determinations of their volumes the oven-dry weights could be interpolated by means of the oven-dry weight/volume ratio of the alternate reserve pieces, the dry weights of which were determined directly.

Very satisfactory surface disinfection was accomplished by plunging the pieces into boiling distilled water for 5 seconds and placing them singly in sterile Kolle flasks, which were then immediately plugged with sterile cotton.

Polyporus versicolor (L.) Fr. was chosen to test the durability of the steamed gum because of its importance as a decay-producing organism of hardwoods and because of its comparatively rapid and uniform growth under favorable conditions. The inoculum, as bits of mycelial mat, was placed uniformly with a needle over both broad surfaces of each test piece.

The test material was incubated in a controlled humidity room maintained at a temperature of 80 degrees F. and a rela-

tive humidity of 90 per cent. Under such conditions drying out of the wood was slow, and no provision for replenishing the moisture content of the pieces was necessary over the period of the test. The method of incubation of the test pieces within Kolle flasks is shown in Figure 1.

The effect of steaming on durability was determined from the relative losses in weight due to decay under uniform conditions. For Series B, beginning 3 days after inoculation, 2.5 pieces of each of the steamed and unsteamed groups were removed each week, the final pieces remaining in the flasks a total of 65 days; for Series A the procedures were the same, but the last set of blocks remained two weeks after the completion of Series B, thereby totalling 79 days. On removal of the pieces, the surface mycelium was picked off and the oven-dry weight found. The extent of decay was determined by the per cent loss in weight and of specific gravity of the test blocks after the several incubation periods. Specific gravity was based on the green volume and the oven-dry weight.

RESULTS

Penetration of the fungus was rapid and the inoculated blocks were uniformly decayed throughout. The establishment of a mycelial cover over the test blocks was slightly more rapid in the case of the unsteamed controls. This advantage was apparent for only 2 weeks, after which the mycelial covering became progressively heavier on the steamed blocks (Figure 1). Whether this early difference in surface growth resulted from significant differences between the surfaces of the steamed and unsteamed wood cannot be answered at this time. A possible explanation might have been found in lower surface moisture and a steeper moisture gradient in the steamed samples.

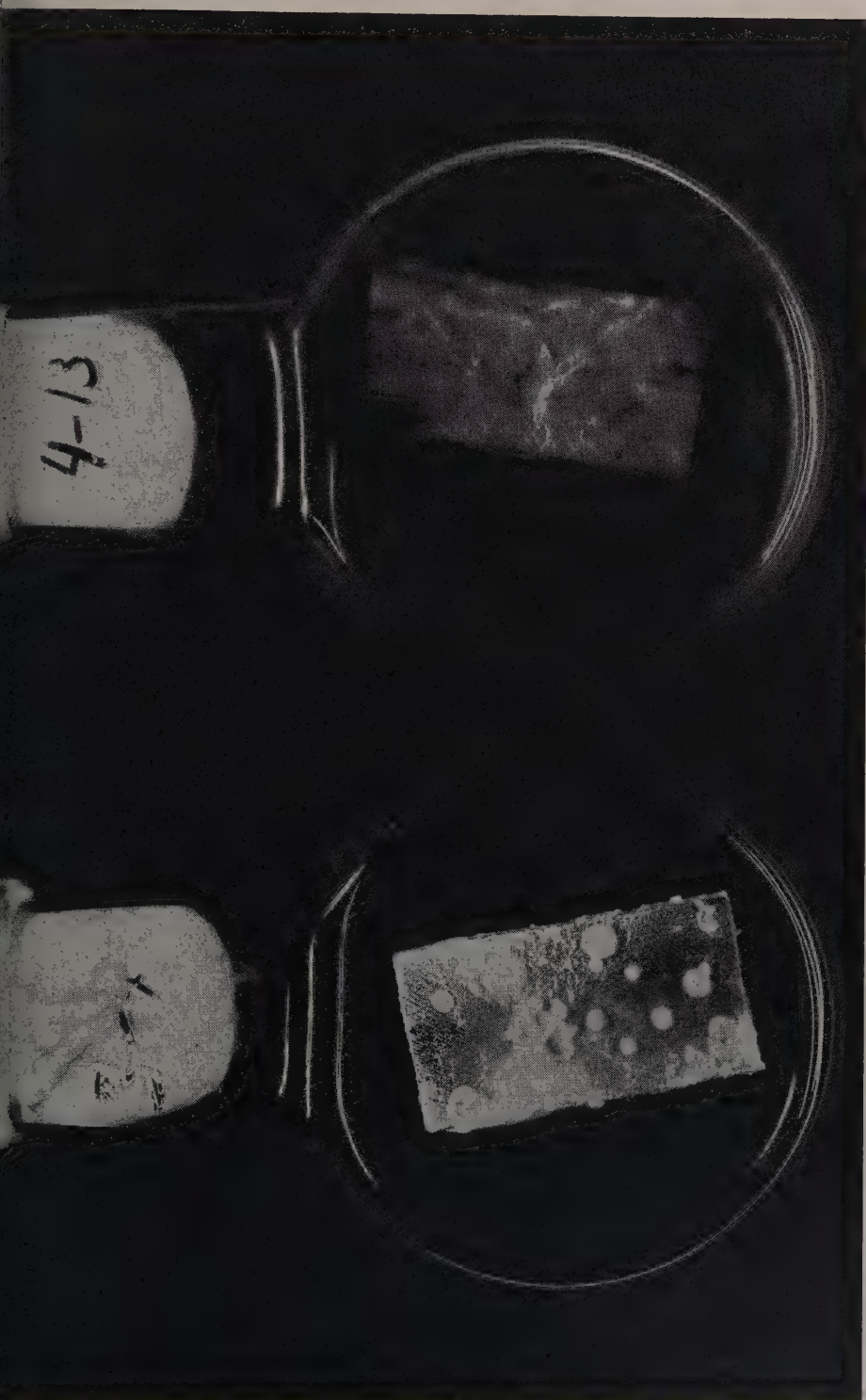


Fig. 1.—Surface growth of *Polyporus versicolor* on steamed (left) and unsteamed sap gum after 3 weeks' incubation.

than in the unsteamed. The density of the surface mycelium was later found to be a rough indicator of the extent of decay within the blocks.

A comparison of the extent of decay in the steamed and unsteamed blocks of both series of tests is given in Table 1. The significance of the decay results is further emphasized by a graphic presentation of the data in Figure 2.

Of the total number of specimens represented in Series A and B combined, and involving 44 blocks each of steamed and unsteamed sap gum, the steamed blocks were, without exception, more

heavily decayed than the unsteamed. Based on the ratios of weight loss per cent steamed to weight loss per cent unsteamed, Fisher's probability table gives odds of better than 100 to 1 for the significance of the greater loss in weight of the steamed blocks in Series A, and even greater significance for the same results in Series B.

In Series B the differences between the per cent loss in weight for the steamed and unsteamed blocks were increasing greater as the incubation period was prolonged. The same was ultimately true for Series A, but the irregular rate

TABLE I

RELATIVE DURABILITY OF STEAMED AND UNSTEAMED SAP GUM BLOCKS INOCULATED WITH *Polystictus versicolor*

Decay period	Condition: Steamed (S) Unsteamed (U)	No. blocks	Average original moisture	Average specific gravity, original	Average loss in weight	Difference between per cent loss in weight of steamed and unsteamed gum	Ratio: % wt. loss (S) % wt. loss (U)
Days			Per cent ¹		Per cent		
SERIES "A"							
30	S	3	140	.411	4.3		
30	U	3	152	.413	3.9		
37	S	3	147	.410	8.1	0.2	1.02
37	U	3	153	.410	7.9		
44	S	4	145	.412	10.4	7.0	3.05
44	U	4	148	.419	3.4		
51	S	4	147	.409	11.6	4.4	1.61
51	U	4	154	.412	7.2		
58	S	5	141	.411	13.6	7.5	2.22
58	U	5	152	.414	6.1		
65	S	5	144	.408	16.4	4.7	1.40
65	U	5	151	.416	11.7		
79	S	4	144	.403	20.9	8.4	1.67
79	U	4	152	.419	12.5		
SERIES "B"							
30	S	2	93	.487	5.2		
30	U	2	116	.467	1.2	4.0	4.33
37	S	2	98	.489	7.9		
37	U	2	105	.476	3.6	4.3	2.19
44	S	2	112	.468	12.9		
44	U	2	121	.456	4.8	8.1	2.69
51	S	2	93	.489	14.3		
51	U	2	115	.466	6.0	8.3	2.38
58	S	3	108	.475	18.4		
58	U	3	113	.473	8.0	10.4	2.30
65	S	3	100	.479	21.3		
65	U	3	115	.467	6.3	15.0	3.38

¹Original moisture content and specific gravity determined from control blocks taken adjacent to decayed blocks. Specific gravity based on green volume.

decay in the unsteamed blocks prevented such definite progressive differences. This was readily brought out in Figure 2. For example, the difference in percentage of decay for the steamed and unsteamed blocks at the end of 30 days in Series A averaged 0.4, while at the end of 79 days incubation the difference was 8.4. In Series B the increase in differences was even more pronounced—differences in per cent decay being 4.0 at the end of 30 days and 15.0 at the end of 65 days.

In this connection it is interesting to observe that the rate of decay of the steamed blocks of both series over the entire periods of incubation was more uniform than with the unsteamed blocks. From the limited data it can be suggested only that the effect of steaming had been to produce a larger directly available food supply for the fungus, thus diminishing irregularity of growth resulting from unknown environmental differences, the influence of which is always noticed when time is used as a basis for comparing degrees of decay.

After the 30-day period of incubation, the ratio of per cent weight loss of the steamed stock to that of the unsteamed stock was generally greater for Series B. Since both series were otherwise treated exactly alike it is quite possible that the 10 degree higher steaming temperature used for Series B might account for this difference. The relative biological effect of different temperatures and steaming periods on wood, however, is not known.

DISCUSSION

The results of these experiments indicate that steaming of sap gum as practiced by some hardwood mills in the South renders the wood more susceptible to decay while in the green condition. The differences in the amount of decay between the steamed and unsteamed stock cannot be ascribed to differences in the moisture contents of the two materials, since although steaming was unavoidably accompanied by losses in moisture, the resultant moisture contents in

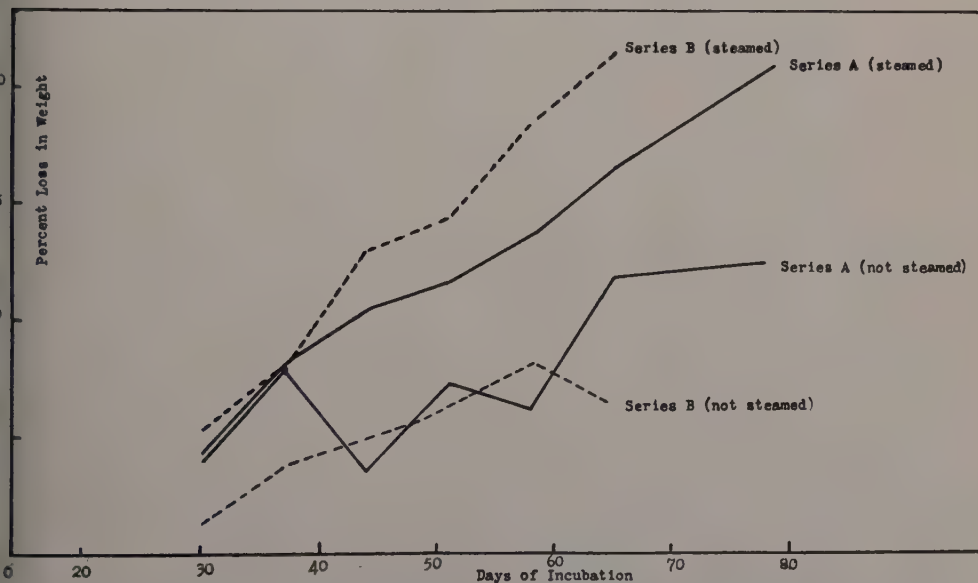


Fig. 2.—Decay caused by *Polyporus versicolor* on green steamed and unsteamed sap gum wood.

all cases were little below those of the unsteamed.

For Series B the coefficient of correlation between moisture difference and log loss in wt (S)
ratio $\frac{\text{loss in wt (S)}}{\text{loss in wt (U)}}$ is +.63, but doubt-

fully significant in view of the small number of tests. In Series A the correlation is negative, —.38, though at the general moisture level of Series A there would be much more reason to expect that the lower moisture content of the steamed blocks might favor decay. Furthermore, previous work with *Polyporus versicolor* on sap gum has indicated its capacity to cause rapid decay over a wide range in moisture contents. This is forcefully brought out in the present study from a comparative analysis of the extents of decay in Series "A" and Series "B." The percentage moisture contents of the steamed blocks in Series "A" averages higher by 44 than those in Series "B," yet the rates of decay are not greatly different. Analyzing further, it may be seen that the average difference between the per cent moisture contents of the unsteamed blocks of Series "A" and Series "B" is 38 and is accompanied by no regular differences in rates of decay whatsoever.

Just what changes took place in the wood as a result of steaming are not known, although it would seem that they were of the nature of increases in readily available nutrient materials rather than the elimination of naturally occurring toxic matter. Sap gum extractives seem in general to be readily utilized by fungi. From the fact that differences between the amounts of decay of the steamed and unsteamed blocks increased at an approximately uniform rate over the entire period of the study, it might be concluded that the underlying chemical changes had been quite extensive. The results may be readily explained if it is

assumed that a partial hydrolysis of materials in the direction of that ultimately caused by the fungus enzymes had taken place. *Polyporus versicolor* attacks both cellulose and lignin vigorously, and it is possible that one or the other or both of these major wood constituents was altered by steaming. A change in a lesser component alone would not be expected to sustain the advantage of steamed wood for decay over such an extended period. Judging from the chemical analytical results available, however, it would seem that such a steaming process as was used would give only a mild hydrolysis either rendering soluble or slightly modifying a very small portion of the carbohydrates and lignin.

PRACTICAL SIGNIFICANCE

When properly conducted and followed by good drying practices, the preliminary steaming treatment has been of wide usefulness in reducing the occurrence of fungus defects during seasoning. However, the data presented herein indicate that steamed green stock under certain conditions of handling is more susceptible to some fungus defects than steamed material. This points to the need of observing certain precautions in the handling of such stock if deterioration during air-seasoning is to be avoided. In the case of the stock tested, such practices as permitting the steamed stock to cool in the steam box without sufficient air circulation, to be drenched with rain or to be bulk piled for long periods of time before piling, would be hazardous. Necessary precautionary measures to be followed in handling such stock are: (1) remove the stock from the steam box as soon as possible after steaming; (2) allow the stock to remain on sticks after removal from the steam box, to protect it from rain, until the temperature of the stock has reached air temperatures; (3) keep to a minimum

ne that the stock is solid-piled prior to ing in the air-seasoning yard; (4) e stock in the yard sufficiently open insure rapid drying of the lumber hout excessive checking; (5) provide properly elevated and tight roof to the oning pile.

It should be emphasized that these re- ts cast no reflections on the practica- ity of steaming as a preliminary treat- nt, or on the durability of seasoned o-gum lumber which has been steamed. e effect of seasoning on subsequent rability has occasioned considerable pute, but the slight evidence at hand icates that air-seasoning may in some es increase durability and conceivably ght obliterate original differences in ay resistance such as occurred in the terial tested.

SUMMARY

Preliminary steam treatment of sap- n lumber as practiced by some hard- od sawmills was found to lower the istance of the unseasoned lumber to ay caused by *Polyporus versicolor* under controlled laboratory condi- ns. The increased susceptibility to ay occasioned by steaming became re pronounced with each progressive t period. The rates of decay over the iod of the study were noticeably more

uniform in the steamed than in the un- steamed wood. The changes in the steamed green wood underlying the in- creased susceptibility to decay and wheth- er the effect of steaming on durability continued in the wood after seasoning were not determined. The results indi- cate the need for using proper methods of steaming and of handling the stock subsequently, if the aims of steaming are to be obtained.

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CHANGES RESULTING FROM THINNING IN YOUNG PINE PLANTATIONS

By W. R. ADAMS

Vermont Agricultural Experiment Station

THE endeavor to produce trees of good form and rapid volume production which have high quality wood through thinning in pine stands necessitates the inception of growing conditions which will bring about the desired results. Regardless of the age of the stand, when a thinning is made certain changes in the physical factors of the site obviously occur. There are very few records of the changes in the various physical factors which occur under such circumstances. There is sufficient evidence from data obtained by numerous investigators in different localities to indicate that both height and diameter increments may be increased following a thinning operation. The height increment has been shown to be affected in only exceptional cases, whereas increased diameter increment seems to be the common occurrence.

The thinning operation in itself merely creates a difference in the space arrangement of the trees in the stand. The disturbance of this physical relationship by the thinning operation actually brings about the changes in the physical factors of the site, which to a large extent influence the growth of the trees in the stand. The changes which occur may be either immediately beneficial or detrimental to the tree growth. In either case the change which exists during the first growing season following the operation will be modified during the succeeding seasons. Furthermore, in either case, after the lapse of a few years, greater volume increments usually occur in thinned stands than in unthinned stands.

The changed physical factors may such as to result in greater volume growth of the dominant trees as well as the continuance of good form development. However, there is the possibility that thinning may result in such a change as one or several of the factors that tree growth may be retarded for a few years. This condition may not be observed in cases where growth measurements are not made until five to ten years after the thinning operation.

It is not always feasible to determine the changes in the physical factors following thinnings, but such information is undoubtedly beneficial in laying a more definite foundation for thinning practice. It was possible to determine the changes in some of the physical factors of the site following thinning operations in two young pine stands in northwestern Vermont.

A plantation of northern white pine (*Pinus strobus*, L.), 21 years of age, and one of Scotch pine (*Pinus sylvestris* L.) 18 years of age, were thinned in 1921. These plantations were located on the Lake Champlain sand plain near Burlington. The white pine was spaced 4' x 6' on a level clearing of the sand plain while the Scotch pine was spaced 5' x 5' on a 20 degree slope with a southwesterly exposure.

THINNING

A light thinning was made in each plantation. In the white pine a number of larger trees had been repeatedly weeviled but had not been removed, that at the time of thinning they were moved as worthless material. Previous

thinning, the plot treated had a basal area of 103.53 square feet per acre. In the combination thinning and improvement cutting applied, 44.6 per cent, or 22 square feet of basal area, was removed. Aside from the removal of the large badly weeviled trees the operation approached a "B Grade" low thinning.

In the Scotch pine plantation the basal area on the thinned plot was reduced from 116.76 square feet to 81.19 square feet, a reduction of 35.57 square feet, or 34 per cent. For each plantation a check plot was maintained for the purpose of comparing the growth increment and the physical factors of the environment.

EFFECT OF THINNING ON GROWTH

The basal area increment of the stand, the volume increment, and the quality of the wood of the selected final crop trees in the unthinned plots in the plantations were considered as that which would normally occur. The percentage differences in these responses to the environment were calculated for the trees in the thinned plots. Table 1 shows that for four years there was a greater basal area increment and volume increment of the dominant trees in the thinned white pine plot. The 47 per cent difference in the volume increment of the dominant trees in this plantation was due to the removal of one of the largest trees in the thinned plot. Thus the volume increment of the selected final crop trees in the thinned plot was based on initially smaller trees than occurred as dominant trees in the unthinned plot.

The 31.8 per cent difference in volume increment in the lightly thinned Scotch pine plantation, where no large trees were removed, suggests the possible dif-

ference in volume increment which might have occurred in the white pine plantation under different circumstances.

MEASUREMENT OF PHYSICAL FACTORS

The physical factors of the site, namely, shade air temperature, relative humidity, wind movement, evaporation, and solar radiation, were measured during June, July, and August for the first four years following the thinning. These measurements were made in each plot in the crown canopy, on a level with the mid-point of the average crown depth (from 18 to 20 feet above the ground), and at a level 8 inches above the ground. In addition the precipitation reaching the soil, the soil moisture, and the soil temperature were recorded.

Friez recording instruments were used for securing the data on the air and soil temperatures and the relative humidity. Daily records were taken of the wind movement, evaporation, solar radiation, precipitation, and soil moisture.

The data so secured during the three years following that in which the thinning occurred was subjected to statistical analysis. The details of this analysis have been published in a previous paper.¹

EFFECT OF THINNING ON THE PHYSICAL FACTORS

Comparing the data secured in the unthinned plots with that in the thinned plots, it was found that the "B grade" thinnings resulted in certain definite changes in the physical factors of the site in each of the three years analyzed. By grouping the data secured for each factor during each year, a general conception may be obtained of the changes which occurred as a result of the opera-

¹Studies in tolerance of New England forest trees. XII. Effect of thinning in plantations on some of the physical factors of the site and on the development of young northern white pine (*Pinus strobus*, L.) and Scotch pine (*Pinus silvestris*, L.) Vt. Agr. Exp. Sta. Bull. 390. 1935.

tion carried out in each plantation.

The mean values of the factors do not seem to be the most desirable figures to use in all cases, in that they do not show the critical periods of the environment which may occur. Undoubtedly liberties have been taken in this case in selecting certain intensities of the various factors to illustrate the character of the changes which occurred. For example, the mean air temperature reflects the influence of the low nightly temperatures, which may merely act as a moderating influence on the physiological activity of the tree. However, the higher temperatures during the day, although of relatively short duration, occur when other factors also contribute to the resultant physiological activity. Likewise, it is of little value to know how much water is present in the soil provided that amount does not approach the point of saturation and the exclusion of air from the soil. But it is important to know the effect of thinning on the available soil moisture during those periods of the year when the soil moisture is normally low.

It has been assumed that the maximum shade air temperature and minimum relative humidity data were of more importance than the averages of these factors, since the maximum air temperature and minimum relative humidity indicate to better advantage the influence of these factors on the physical factors of the soil and the physiological activity of the tree.

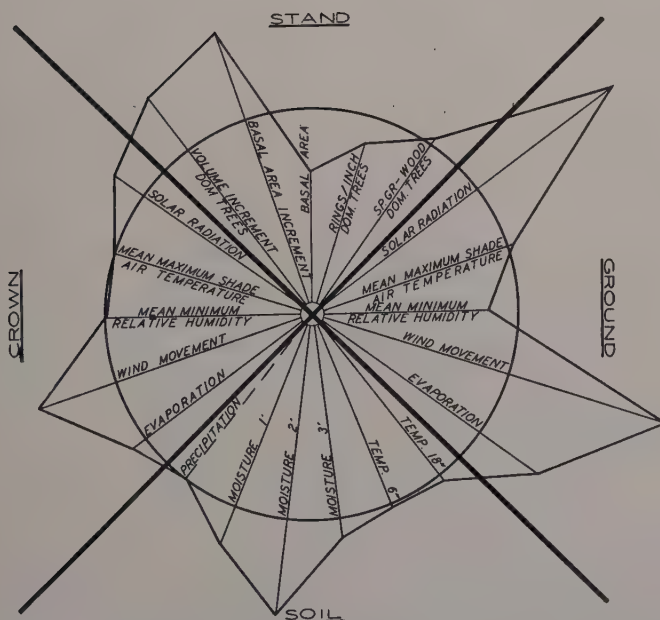
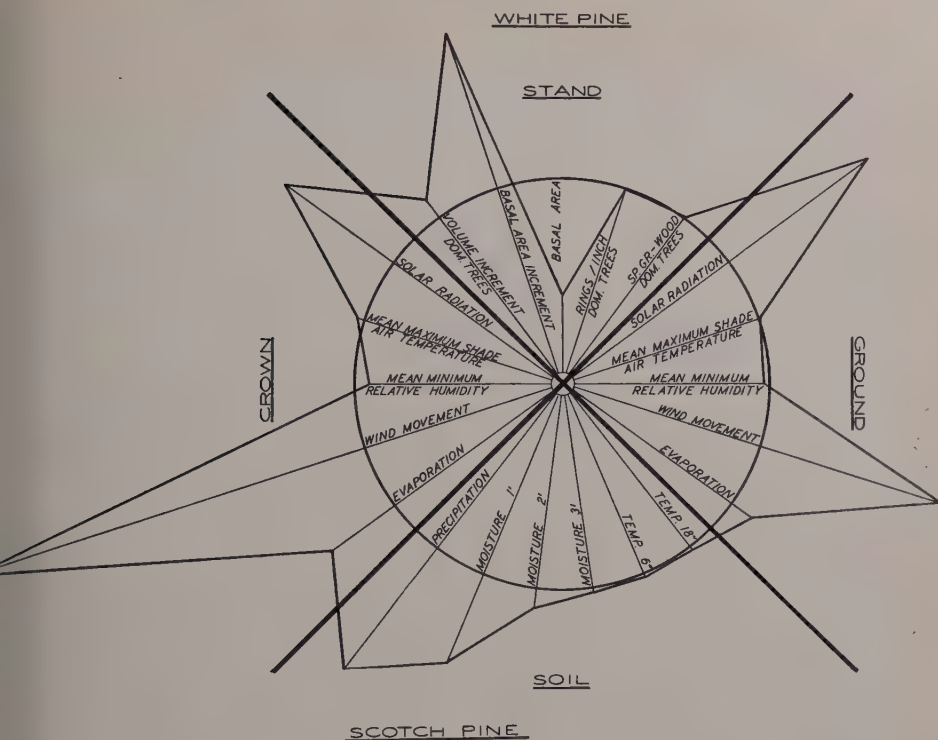
The average available soil moisture content at various depths in the soil for the entire growing season may be no different in one plot than in the other. This happened to be the case in these plots. Still it was evident that, during the later part of July and the month of August, the available soil moisture in the thinned plots was greater than in the check plots. Thus, for this factor, a comparison was made of the available moisture in the soil of the two plots of a plantation with the available soil moisture in the unthinned plot was below the average of the three summer months.

Calculating the percentage increase or decrease in the factors in the thinned plots when the conditions in the unthinned plots were considered as unity, the changes which occurred as a result of thinning are shown in Table 2.

Figure 1 shows the data in Tables 1 and 2 presented as a composite diagram of the changes in the conditions of the stands and the physical factors of the sites. In the construction of these diagrams, the intensities of each factor at the beginning of each of the conditions of the stand in the unthinned plots were considered equal to 100 per cent. Thus the development of the trees and the stand as a whole as well as the intensities of the physical factors of the site in the unthinned plots are represented by the large circle. The polygon symbolizes the percentage of the changes which occurred in the thinned

TABLE 1
DIFFERENCES OCCURRING IN THE THINNED PLOTS
(EXPRESSED IN PER CENT PLUS OR MINUS THE CONDITION IN THE UNTHINNED PLOT)

	White pine	Scotch pine
Entire plot		
Number of living trees.....	— 55.7	— 31.4
Number of living and dead trees.....	— 59.3	— 44.2
Basal area (square feet).....	— 44.6	— 30.4
Basal area increment (square feet).....	+ 80.4	+ 44.6
Dominant trees		
Volume increment (cubic feet).....	+ 12.1	+ 31.8
Number of rings per inch of wood.....	— .1	— 13.2
Specific gravity of wood.....	+ 1.5	+ 3.6



1.—The change in the stand, tree growth, and site factors as a result of thinning in young plantations. The large circles represent the conditions and factors as they exist in unthinned plots. The polygon connecting the ends of the radii shows percentage difference in each condition and factor in the thinned plots. The diagrams represent four years growth of the stand and trees, and a summation of the site factors for June, July, and August of the last three growing seasons.

plots. It was constructed by connecting the plus and minus points of the various radii of the circle which are representative of the factors and stand conditions.

The intensity of certain factors was greatly increased as a result of the thinning. Wind movement in the crowns showed the greatest increase. Very little attention has been given this physical factor in silvical studies because of the integrate relations which exist between wind movement and the other physical factors of the site which affect the physiological activity of the tree.

In the white pine stand there was a greater influx of warm dry air from the open adjacent pasture land during the day. Such an occurrence was reflected in the higher mean maximum shade air temperature, lower mean minimum relative humidity, and increased evaporation in the canopy. Similar changes took place within the stand as recorded 8 inches above the ground. In the Scotch pine plantation the increase in wind movement was not so great because the direct force of the southerly winds struck directly into the crowns of each tree on the side hill.

In the canopy such changes might imply certain physiological responses of

the needles. Greater solar radiation reaching the mid-point of the crown depicts higher air temperature, lower relative humidity, and higher evaporation might tend to increase such activities as photosynthesis, transpiration, respiration, and evaporation. The metabolic responses to these activities would account for greater wood volume production in the main stem and eventual increase of the crown density of the individual trees. The latter itself to a certain extent would tend towards greater wood volume production in the main stem during succeeding years provided the soil moisture remains available.

The changes in the physical factors in the air near the soil surface influence the soil conditions. With the opening of the crown canopy, a higher percentage of precipitation reached the soil during summer season. Early in the season when the soil moisture supply was plentiful, a more rapid depletion of this moisture occurred in the thinned plots. Later in the season when the soil moisture supply was low in both plots, there was a higher percentage of available soil moisture in the thinned plots.

Increased direct solar radiation reaching the soil surface in the thinned plots

TABLE 2

PERCENTAGE DIFFERENCES IN THE PHYSICAL FACTORS OF THE SITE DURING JUNE, JULY, AND AUGUST FOR THREE SUCCESSIVE YEARS

(EXPRESSED IN PER CENT PLUS OR MINUS THE CONDITION IN THE UNTHINNED PLOT)

	White pine		Scotch pine	
	Crown	Ground	Crown	Ground
Solar radiation	+ 65.3	+ 85.2	+ 18.7	+ 18.7
Mean maximum shade air temperature	+ 4.1	+ .02	+ .45	+ .45
Mean minimum relative humidity	- 5.5	- 2.5	- .14	- .14
Wind movement	+ 197.2	+ 92.3	+ 39.1	+ 39.1
Evaporation	+ 39.9	+ 12.7	+ 7.4	+ 7.4
Precipitation	Soil + 74.9		Soil data faulty	
Available soil moisture				
first foot	+ 47.6		+ 19.8	
second foot	+ 10.7		+ 46.4	
third foot	+ 2.7		+ 9.5	
Soil temperature				
6-inch depth	+ 1.9		+ 1.7	
18-inch depth	+ 2.0		+ 2.9	

sulted in higher soil temperatures at depths of 6 and 18 inches. Increase in the soil temperature causes increased root growth and activity. However, there is no data available which will permit an evaluation of the extent of the increased root activity for slight increases in soil temperature when such increases persist for an extended period.

SUMMARY

The thinning in the two pine plantations resulted in similar definite changes in the physical factors of the site. The extent of the changes varied somewhat with the intensity of the operation and the exposure of the site.

Solar radiation, wind movement, and evaporation were increased, while the mean maximum shade air temperature and mean minimum relative humidity were decreased both in the crown canopy and 8 inches above the ground. When the available soil moisture was below the

seasonal average, there was a higher percentage available in the thinned plots. Soil temperature at depths of 6 and 18 inches was increased as a result of the increased solar radiation reaching the forest floor.

In the white pine plantation, with a reduction of 45 per cent of the basal area there was an 80 per cent greater basal area increment in four years. The volume increment of the selected final crop trees was found to be only 12 per cent higher, due to the removal of larger weeviled trees before thinning.

With a 30 per cent reduction of the basal area in the Scotch pine plantation there was a 45 per cent greater basal area increment in four years. The dominant selected final crop trees showed a 32 per cent greater volume increment than similar trees in the unthinned plot. In addition the wood of the dominant trees in the thinned plot showed a 13 per cent reduction in the number of growth rings per inch of radius and a 4 per cent increase in the specific gravity.

EFFECTS OF VARYING DENSITIES OF HARDWOOD COVER ON GROWTH AND SURVIVAL OF SHORTLEAF PINE REPRODUCTION

By W. R. BECTON

Pike National Forest

SOUTHERN pine seedlings frequently catch and survive for at least a short time under dense canopies of hardwoods, and in some cases eventually grow through and over-top these canopies. Where the seedlings are not killed, they are held down in height growth and are more subject to death from fires. This has been noted for all species of southern pines. Measurements made reveal that the rate of height growth is determined, when competing with hardwoods, by the degree of the density, as measured in terms of height of and nearness of the hardwoods to the individual pines.

With these facts in mind, a study was made to measure accurately the effects of varying densities of competing hardwoods on the growth and survival of shortleaf pine (*Pinus echinata*) on State Forest number Three, at Maydelle, in East Texas.

The history of the Forest is as follows: The original stand of shortleaf pine was cut over in 1911 to an 8 inch diameter limit. This left many small pole-size trees and some large defective ones. The small pole trees generally occurred in patches, which left many open spaces between these patches. The large defective trees were left as individuals. These two classes of trees served as seed producers; but few seedlings became established, due to the annual fires. In the blank spots, among the patches of pole-size trees left from the original cutting, hardwood reproduction was successful in becoming established. In 1926, fire protection was inaugurated, and after this when there were good crops of seed, pine reproduction came in under the hard-

woods that had covered the blank spots.

The fires during the period 1911-1926 had kept the density of the hardwoods lower, and had slowed down the rate of growth. This helped the pines become established. Since protection from fires was started in 1926, the rate of growth and density of the hardwoods has increased, and at the present time almost half of these open spots—those not having a well advanced stand of pole-size pines—are being held exclusively by the hardwoods, which are choking back the pine reproduction that has become established since 1926. It is doubtful whether hardwoods have any material effect on the growth of the older trees left from original cutting, but there is a decided effect of the hardwoods on pine reproduction becoming established under their canopies. The brief study made so far points toward a very slight effect of older pines on the growth of the hardwoods. There is sufficient evidence showing that pine will gradually dominate the stand and be only slightly influenced by the hardwoods where it can become established at the same time, or even a little later than are the hardwoods. Actual measurements show, on site index 50, that the normal average annual height growth of pine is 14.6 inches per year for the first 10 years, while the average annual height growth of hardwoods on the same site is 11.3 inches during the same period. Most of the growth of the hardwoods is made during the first 3 years; during this period the average annual height growth is 28 inches, and after this the growth is only 9.5 inches per year.

METHOD OF STUDY

Individual specimens of pine reproduction were chosen, mainly at the ages of 1 and 6 years, since most of the pine reproduction was of this age. Only specimens were used having definite competition from at least 3 hardwoods. The age of the pine was ascertained, the height was measured, then the average height growth in inches per year was figured for each tree. By means of a number of stem analyses of typical hardwoods, the average normal height growth was determined. See Figure 3 for nor-

mal height growth of hardwoods on sites where shortleaf pine has site index 50. Only this site class was studied in detail. On better sites the hardwoods grow more rapidly, and so does the pine, resulting in identical relationships as set out in this article.

The distance to each competing hardwood was measured and the average obtained. The height of each competing hardwood was measured and the average obtained. This gave the average height and the average distance of the competing hardwoods in the case of each pine studied. One-half the total height of

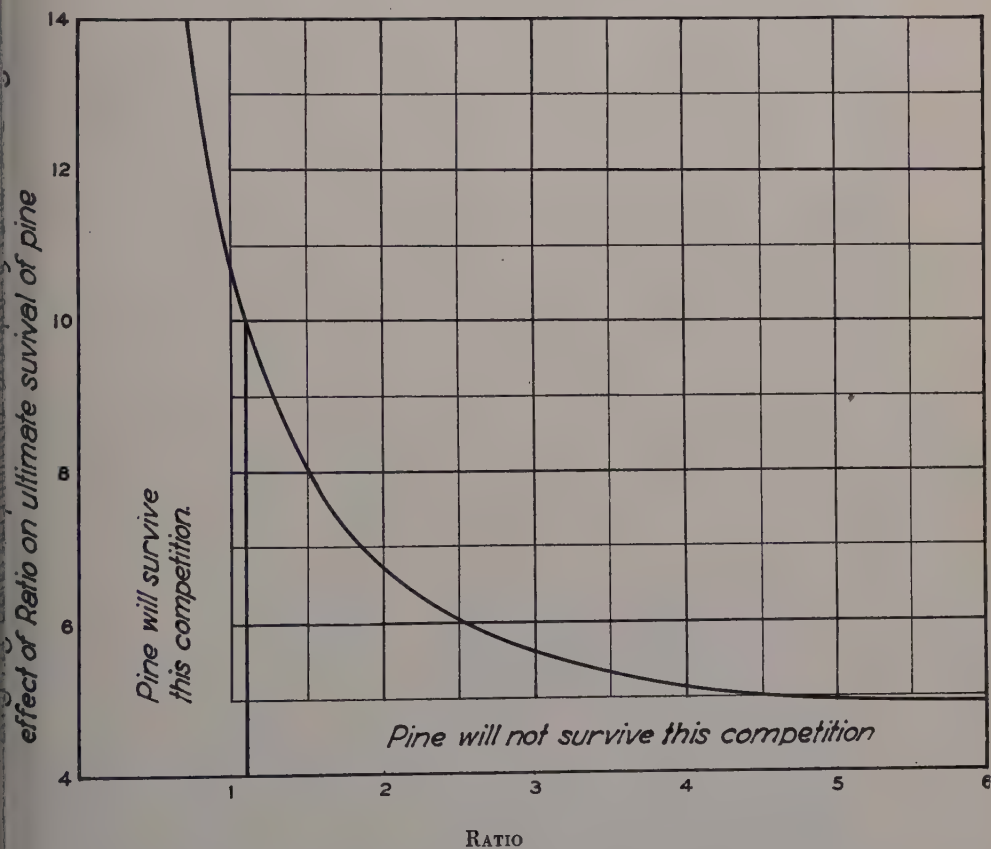
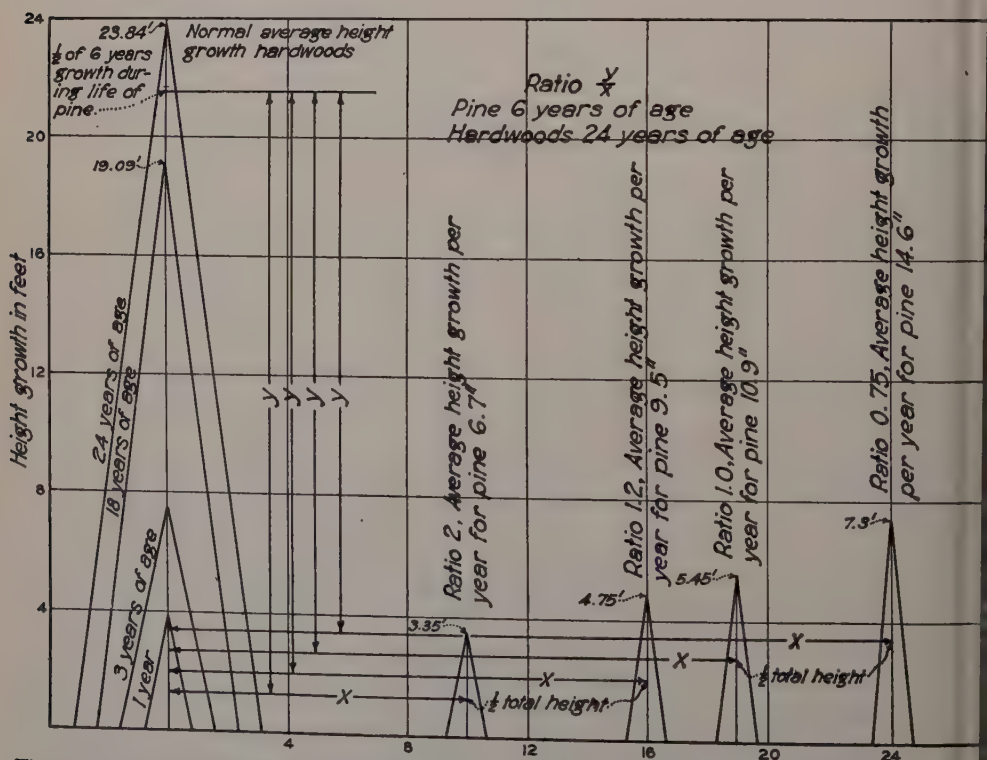


Fig. 1.—Ratio $\frac{y}{x}$, where y is the average height of hardwoods during the life of the pine minus the average height of the pine during its life, i.e.: the average height of hardwoods above the pine. x is the average distance of at least three hardwoods from the individual pines studied. Site index shortleaf pine 50.

each pine was subtracted from the average height of the competing hardwoods during the life of the pine. This gave a more constant relationship than using the figures for total height of pine and total average height of the competing hardwoods at the time of study. The average distance from the pine to the competing hardwoods as found from the above explanation (see Figure 2, line "x," divided into the figure for value of line "y"), gives a ratio which may be around 1 in the case of low scattered hardwoods, or it may be as high as 6 where the pine is under tall dense hardwoods. A number of these ratios were plotted and a curve drawn to find averages. See Figure 1. This graph shows that the more dense and tall the hardwoods, the slower the growth of the pine reproduction coming under them.

DISCUSSION

It is obvious that the pine reproduction must grow faster than the competing hardwoods, or it can never overcome competition. By consulting Figure 1, ratio can be picked out which must exist for the pine to survive. This is 1.1 lower. If the ratio is larger, the result will be stagnation of growth of the pine and eventually death. If the ratio is less than 1.1 the height growth of the pine will be more rapid than that of the competing hardwoods, resulting in an accelerated lowering of the ratio until finally, when it reaches .75, the effect of former competition of hardwoods will be zero. See Figure 3 for pine with ratio 1.0. On the other hand, if the ratio is larger than 1.1, the competing hardwoods will be growing more rapidly than



ne, resulting in an accelerated increase the ratio until final killing of the pine. e Figure 3 for pine with ratio 2.

This study was conducted entirely on e same type of soil, site index pine 50, order to eliminate as many discrepan- es as possible in the length of time available for this study. The hardwoods e typical of those occurring in the pine rdwoods type of the southern pine re- on—red or Spanish oak, (*Quercus ru-* a), black-jack oak, (*Quercus mariland-* a), hickory (mainly *Hicoria glabra*), d gum (*Liquidamber styraciflua*), and me others in minor quantities. Mea- rements made on other types of soil ing out the fact that these relationships ld for any type of soil. On richer ils the hardwoods would grow faster

than $9\frac{1}{2}$ inches per year after the third year, but the pine would also grow more rapidly, with the same competition re- sulting in identical relationships.

It is believed that these effects on growth of shortleaf pine will be fairly constant for the other species of southern pines, and will furnish an index of what can be expected from an area having a dense stand of hardwood reproduction where a stand of pine is desired. In a great number of instances, this competi- tive growth of hardwoods will have to be removed in part or entirely before a stand of pine can ever be established. Some argument has arisen as to the practicabil- ity of removing this competition by cut- ting the hardwoods down, or by some other means, since they sprout so readily

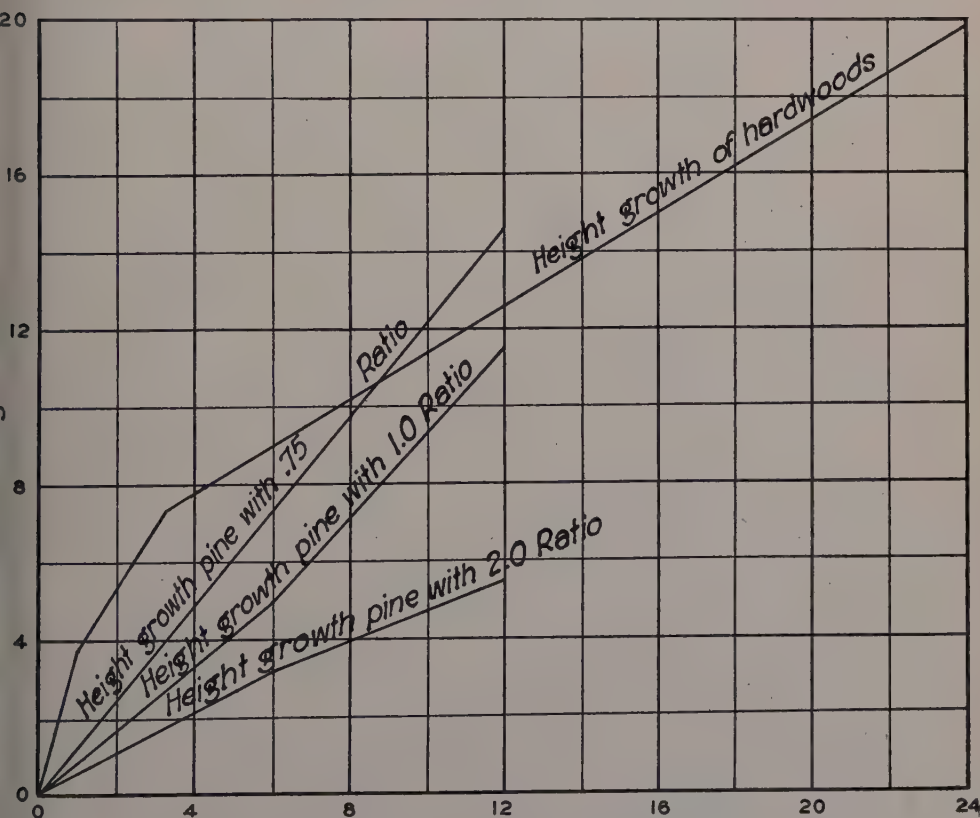


Fig. 3.—Age in years. Site index shortleaf pine 50.

and grow rapidly the first 3 years. A number of these sprouts were measured, and the average growth was $47\frac{1}{2}$ inches for the first year, 20.4 inches the second, and 20.3 inches the third year. For the following years the average was $9\frac{1}{2}$ inches, demonstrating that high trees, 12 feet and up, can be cut down and the ratio reduced sufficiently to give the pine a chance to become established and survive the competition, whereas, if no cut-

ting were done, the ratio would continue too large for the pine to come through. Some of this kind of work has been done by the Civilian Conservation Corps on this Forest. Carefully kept records reveal this to be economical, since never more than two-man days per acre were required where the hardwoods were from 3,000 stems per acre up, having an average diameter of $2\frac{1}{2}$ inches at breast height.

A COMPARISON OF SEVERAL METHODS OF MAKING MOISTURE DETERMINATIONS OF STANDING TREES AND LOGS

By B. J. HUCKENPAHLER¹

Soil Conservation Service, Greensboro, N. C.

N sampling logs and trees for moisture content, physiologists, wood technologists, and more recently entomologists, have always been confronted by the problem of which method to use in order to insure accurate results.

Several methods have been employed in the past, including determinations on whole cross sections, increment cores, auger borings, and groups of rings chipped from cross sections, but there is no available information on a comparison of the results obtained by the various methods.

The purpose of this study, conducted by the Bureau of Entomology in cooperation with the Appalachian Forest Experiment Station at Asheville, N. C., was to determine the correlation existing between the results obtained by the various methods, and provide the basis for correcting the results obtained from a more easily applied method.

COLLECTION OF DATA

The data, collected in July and August, 1932, are from 12 oldfield shortleaf pines, ranging from 6 to 8 inches d.b.h. and 25 to 30 feet tall. The trees were felled and brought into the laboratory for sampling.

In the comparison of the cross section with the increment core method, the following technique was used. A 6-inch section was removed from the end of the log and discarded, a cross section $\frac{1}{4}$ to $\frac{1}{2}$ inch in thickness was then cut, cleaned

of sawdust, bark, and phloem, and immediately weighed. Two whole increment cores, 1 to $1\frac{1}{2}$ inches apart and at right angles to each other, were then taken from the base of the log, 1 to $2\frac{1}{2}$ inches from the end. These cores were placed in a small glass vial, previously numbered and weighed, and the wet weight recorded. Thus the material for one pair of observations was obtained. This procedure was continued at 6-inch intervals up the tree until a 2-inch diameter was reached. The thickness of the cross section was increased as the diameter decreased to insure a sample of 50 grams or more. Only 2 increment cores were included in each sample, regardless of the diameter. A total of 64 pairs of observations was made.

The cross section and auger boring method comparison was made in a similar manner. A section was removed, cleaned, weighed, and recorded. At 1 and 2 inches above, borings from 1-inch bit holes drilled at right angles to each other were allowed to fall into a small paper bag of known weight, and immediately weighed.

In studying the death of beetle attacked trees, it is desirable to know the progressive drying of the tree from the surface inward. This is best and most accurately determined by a "chipping" process, wherein a cross section of $\frac{1}{4}$ to 1 inch in thickness is cut, cleaned, and weighed immediately; the desired group of rings is then removed from the complete cir-

¹The writer wishes to express his appreciation to A. L. MacKinney and Margaret S. Abell of the Appalachian Forest Experiment Station for suggestions in the biometrical analysis of the data.

cumference by cutting and chipping to the summerwood of the next ring. The remaining portion is then weighed, the difference in weights being the wet weight of the sample removed. Obviously, extreme care should be exercised so that no chips are lost. The procedure can be repeated for successive groups of rings inward. This method not only necessitates felling the tree, but is laborious and tedious in its execution.

To facilitate taking moisture samples of these groups of rings, a series of values was determined by the increment core method and compared with a correspond-

ing series by the chipping method as a test for correlation and accuracy. After taking samples of the 1-3, 4-6, and remaining center ring groups by the chipping method, two whole increment cores were taken at right angles to each other 1 and 2½ inches directly above. The ring groups were cut from the core and the four samples of each put in weighing vials.

In all comparisons, samples were taken from the entire length of the tree to include the factor of the amount of moisture as affecting the degree of correlation between the two methods of sampling.

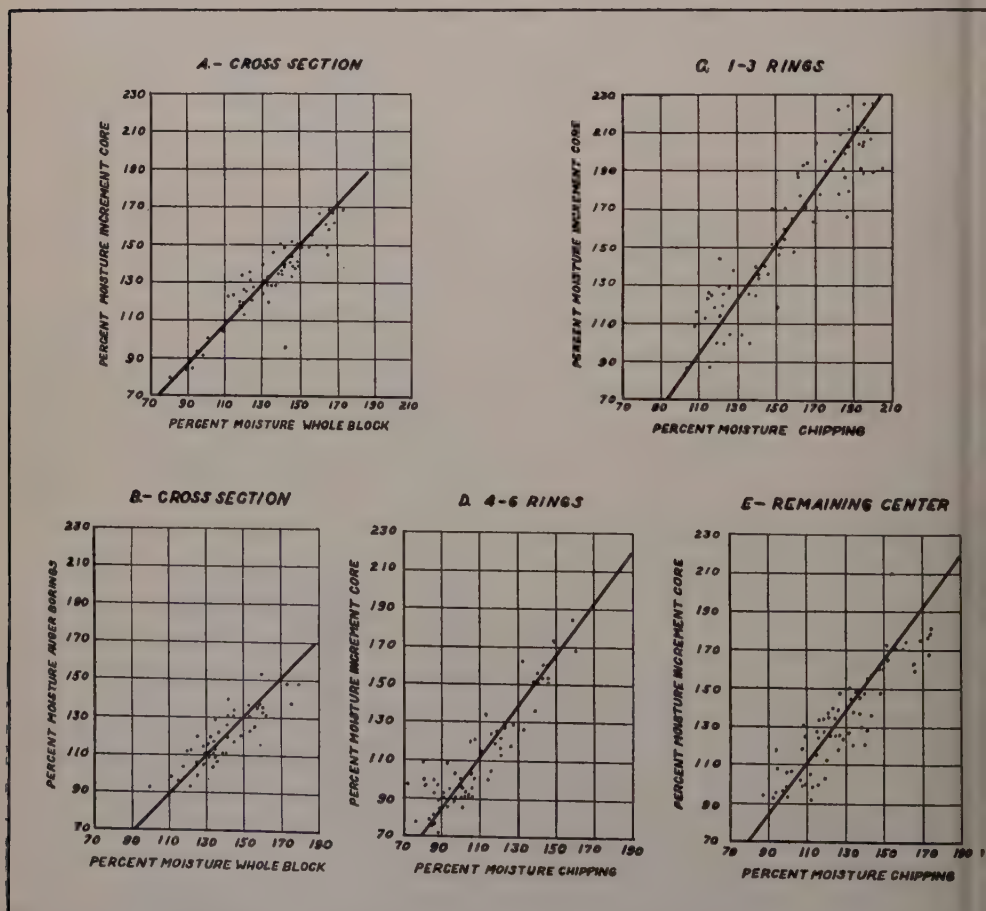


Fig. 1.—Regression lines obtained from regression equations in column 7, table 1.

The work was performed as rapidly as possible without sacrificing accuracy, to minimize drying before the samples were weighed; needless to say, all samples were handled as little as necessary before weighing.

The moisture content was determined on the oven-dry weight basis. All of the samples were dried by means of a Friez electric oven equipped with an automatic thermostat, and blower to maintain a constancy within $\frac{1}{2}^{\circ}\text{C}$. throughout all parts of the oven. Samples were dried at 100°C . and left in the oven until repeated weighing of samples from different parts of the oven showed a constancy within .01 gram or less. This usually required about three days.

ANALYSIS OF DATA

With the cross section and chipping values as the basis, and the auger borings and increment core determinations as variations from them, the degree of correla-

tion, expressed as the correlation coefficient,² was determined for each comparison. The cross section values were used as the basis of comparison because this is the most accurate and commonly applied method. The accuracy and use of the chipping method is not so well established, but the writer is convinced from previous experience that, of the methods tried, it is the most accurate method of determining the moisture content of groups of rings.

Results of the analysis are presented in Table 1. The mean difference between the dependent and independent variables is given in column 3; columns 5 and 6 show the correlation coefficient and its standard error, respectively.

GRAPHICAL PRESENTATION OF RESULTS

Regression lines obtained from the regression equation values in column 7 of the table are represented graphically in Fig. 1A to E, for each comparison. Each

TABLE 1

COMPARISON OF METHODS OF MAKING MOISTURE DETERMINATIONS IN STANDING TREES AND LOGS

(1) Method	(2) Number of obser- vations	(3) Mean dif- ference per cent	(4) Standard deviation of differences	(5) Correla- tion co- efficient	(6) Standard error of correlation coefficient	(7) Regression equation	(8) Error of estimate per cent
Cross section increment core (Y) vs. whole block (Z)	64	-.84	± 6.88	.970	.0073	$Z = 9.12 + .94Y$	± 5.12
Cross section auger borings (Z) vs. whole block (Y)	49	-21.30	± 3.38	.851	.0394	$Y = 22.28 + .98Z$	± 8.80
Outer 1-3 rings increment core (Y) vs. chips (Z)	79	+3.61	± 16.18	.919	.0174	$Z = 45.13 + .69Y$	± 11.88
Outer 4-6 rings increment core (Y) vs. chips (Z)	69	+3.09	± 12.97	.925	.0173	$Z = 25.42 + .75Y$	± 8.66
Remaining center increment core (Y) vs. whole block (Z)	74	+4.39	± 12.30	.888	.0245	$Z = 23.87 + .78Y$	± 10.30

²Computed by the method advanced in: Treloar, Alan E. Outlines of biometric analysis, pt. I. Biometric Laboratory, Department of Botany, Univ. of Minn., 1931.

point represents a pair of observations. The distances between the points and the regression lines show, for the observed data, the error in estimating one value from the other.

DISCUSSION

The regression lines show a varying degree of correlation between the methods. As might be expected, the highest correlation exists between the block and the increment core methods of determining the moisture percentage of the complete cross section. With conditions similar to those under which the original data were taken, the regression line in Fig. 1A, can be used to predict the block cross section value from an increment core determination. However, it is apparent from the scatter of the points and the error of estimate, ± 5.12 per cent, that a single observation is practically valueless. As an example, if a single increment core determination gave a value of 120 per cent, the estimated value by the block method will be, 2 chances out of 3, 122 per cent ± 5.1 per cent, or between 116.9 and 127.1 per cent. Obviously, such a wide range makes an estimate from a single observation almost worthless in careful study. If, however, 100 determinations are made and the average computed to be 120 per cent, the chances are 2 out of 3 that the estimated block value will be 122 per cent $\pm .51$ per cent, or between 121.49 and 122.51 per cent.

The block cross section value can also be estimated from the auger boring method. Of the five comparisons included in the study, this is the only one in which the sign of the difference between the two values is consistent. Nevertheless, the auger boring method is less desirable

than the increment core, both because of the higher error of estimate (Table 1) and the physical limitations involved in its application.

From Fig. 1, C, D, and E, it can be seen that there is also a close correlation between the chipping and increment core methods. The differences are, however, more inconsistent and a higher error of estimate is incurred in a prediction of one value from the other. This is due, perhaps, to the more variable factors involved, such as drying, size of sample, chipping the wood, etc. Nevertheless, by computing the mean of a large number of observations by the increment core method, the corresponding chipping method value can be estimated from the regression lines within accurate limits.

SUMMARY

1. The moisture content at various points in standing trees and logs can be determined without felling the tree or cutting the log in smaller sections.
2. The more accurate block value for the moisture content of the cross section of trees and logs can be predicted by using increment cores as samples.
3. The auger boring value is consistently lower than the block cross section determination. The auger boring method is also mechanically undesirable to use in taking moisture samples.
4. The distribution of moisture in the tree in different parts of the cross section can be determined from parts of increment cores.
5. The actual amount of moisture present has no appreciable effect on the difference between the two methods in any comparison.

INVESTIGATIONS OF NECTRIA DISEASES IN HARDWOODS OF NEW ENGLAND

By PERLEY SPAULDING,¹ T. J. GRANT,² AND T. T. AYERS^{3, 4, 5}

The Nectria diseases of hardwoods have become of unsuspected importance in the forest improvement work of the C.C.C. The definite results of their first intensive investigation in New England are given. These should help to establish a stable foundation for the work of the C.C.C. in this region.

FOREST stand improvement activity has been increased enormously as a result of the Emergency Conservation Work program. The practical control of diseases of young hardwood stands previously had never been attempted on a scale which it needed. Among these diseases, the Nectria cankers are especially important because of their prevalence and destructive action, both of which have been far too little known.

European hardwood forests ranging in age from 5 to 140 years were seriously cankered by Nectria as early as 1865 (12). The European literature on Nectria cankers in forest and orchard trees is extensive. There are conflicting opinions as to the identity of the species of Nectria concerned (1, 15, 20, 21). Practically, the important thing is that serious canker disease is prevalent in European hardwood stands.

In North America the early history of Nectria cankers is more obscure. As early as 1897 Galloway and Woods (7) definitely mentioned *Nectria ditissima* as causing cankers in deciduous shade trees of many species. H. S. Graves and Fisher in 1903 (11) said: "... In the first thinning (of hardwoods in southern New England) he (the woodsman) would take out the dead, dying, and defective trees. Defective trees include those having frog stools or canker scars on their trunks, etc. . . ." This seems to be the earliest definite mention of Nectria cankers on forest trees by foresters in North America. In 1905 Pollock (14) called attention to Nectria cankers in yellow birch forest trees. In 1909 A. H. Graves (8) began observations on Nectria cankers of sweet birch which caused heavy damage locally. Still later he successfully inoculated paper birch with Nectria from sweet birch (9). Again, (10), he

¹Senior Pathologist, Bureau of Plant Industry, U. S. Department of Agriculture.

²Technician, Emergency Conservation Work.

³Agent, Bureau of Plant Industry.

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⁵The authors acknowledge the work of the following in these investigations: R. P. Marshall, Malcolm McKenzie, and C. S. Moses scouted in the spring and summer of 1933 in Maine and New Hampshire to learn the limits of areas where the beech was attacked by the *Cryptococcus-Nectria* disease. Alice J. Watson (E.C.W.) assisted in the mycological work and cultures from July to August, 1933, to date; T. W. Childs in the field work and canker experiments from July to September, 1934; J. R. Hansbrough in the inoculations of the spring of 1934. H. B. Peirson, Maine State Entomologist; Messrs. W. L. Baker, Harry C. Hyson, R. Wooldridge of the U. S. Bureau of Entomology and Plant Quarantine, scouted for the beech *Cryptococcus-Nectria* disease and established the Maine plots, and especially R. C. Brown, in the preceding work and making cooperative notes on the plots since that time. Special acknowledgments are also due James E. Scott, formerly supervisor, M. A. Mattoon, Supervisor of the White Mountain National Forest, and A. F. Hawes, Connecticut State Forester, for permission to carry on these experiments in their forests.

stated that it kills large sweet birch trees and recommended the removal of affected trees. In 1926 the senior author (16) found an outbreak area in Vermont where yellow birch 1 to 2 feet d.b.h. was dying from attacks of *Nectria*. Since then numerous species of hardwoods with *Nectria* cankers, and other outbreak areas where much damage was done, have been noted. Thus it has become evident that the serious type of disease so often mentioned as occurring in European forests is not only present with us, but probably is equally destructive here.

With the beginning of forest stand improvement work by the Civilian Conservation Corps a number of urgent questions arose concerning the most practical method of handling *Nectria* cankers, which could not be answered satisfactorily. Accordingly, Emergency Conservation Work technicians in pathology were assigned to assist the regular personnel in getting the needed information. The present paper presents results of those investigations which are far enough advanced to permit definite conclusions to be drawn. Further work will yield much additional information. It should be distinctly understood that statements made herein apply only to New England.

THE CONTROL OF INFECTION BY NECTRIA

The canker-forming *Nectrias* are so widely and generally distributed, and they fruit so abundantly, that it is obvious that a study of the factors affecting their fruiting is of primary importance in their control. Their abundance of fruiting is a most important factor in the intensification of the disease in outbreak areas. Extensive field experiments on the progress of fruiting, supplemented by laboratory studies, were begun in 1933 and are being continued.

NECTRIA FRUITING AS RELATED TO TREATMENT OF CANKERED TREES

Five different methods of treating cankered trees have been tested to determine the most practical method of reducing perithecial fruiting and spore production to a minimum when the trees must be left in the woods. The treatments tested were as follows:

- (1) Girdled, left standing.
- (2) Felled, left on ground entire.
- (3) Felled with branches removed, left on ground.

(4) Like (3) but with canker edges peeled 2 inches.

(5) Felled and cankered piece, with about 1 foot of sound wood at each end of the canker, cut out and left on the ground. Cankered living trees were left for checks. Series of these 5 treatments were applied to sweet,⁶ paper, gray, and yellow birch; sugar, red, and striped maple; black oak, aspen, largetooth aspen, and beech. The treated trees are located in Connecticut, New Hampshire, and Vermont. The study was started in the fall of 1933 and detailed notes of fruiting activity on the cankers were taken in the spring, midsummer, and fall of 1934.

The observation of 1,164 cankers on trees subjected to the various field treatments indicate that during the first year there is no important advantage of any one treatment over another. Fruiting on the check trees was similar to that on the treated ones, but it should be remembered that fruiting cannot continue indefinitely on dead trees, while it will continue on the living trees until they die. Use of the felled trees for firewood and burning of slash from cankered trees is the best method of disposal where it is possible. Moisture is more important in inducing

⁶See Sudworth, G. B. Check list of the forest trees of the United States, their names and ranges. U. S. Dept. Agric. Misc. Circular 92:1-295. The check list usage for the common names of the trees is followed throughout.

undant spore production than any of the treatments in themselves.

NECTRIA FRUITING AS RELATED TO MOISTURE

In the field experiments just described, it was noted that cankers turned downward in contact with the ground or otherwise kept moist fruited more abundantly than those so situated as to dry quickly in fair weather. Welch (19) has noted this with *Nectria* on basswood. The following laboratory tests were undertaken to supplement the field observations on the relation of moisture to fruiting of *Nectria*.

(A) Ten cankers were taken from the trunk of a single sweet birch. The pieces of trunk were cut crosswise so that each canker was divided in half. The 20 halves were then placed in 4 groups of 5 each, halves of the same canker being placed in different groups. Group 1 was placed in the greenhouse; group 2 outdoors under conifers; group 3 outdoors by the north side of the greenhouse in the shade; and group 4 on a shelf in the laboratory. It is obvious that the environments selected were different and that each was subject to considerable variation. The canker halves placed in the laboratory and the greenhouse were subjected to more uniform conditions than the others.

This experiment was begun in January, 1934, and notes on the total number of perithecia were taken at monthly intervals. Like the cankers on the treated trees in the forest, *Nectria* fruiting is still in progress. The data obtained to March, 1935, indicate that *Nectria* fruiting activity is appreciably affected by environmental factors. The amount of fruiting activity (both production of new perithecia and exhaustion of mature ones) with extension of fruiting to adjacent cut surfaces not previously supporting perithecia

have been followed on the canker halves in each environment. Fruiting activity and surface changes have been definitely greater on the canker halves kept under relatively moist conditions.

(B) Parallel series of 1-inch disks of sweet birch bark infected by *Nectria* were placed in covered Petri dishes with and without water. One series of the Petri dishes was held at room temperature of 65°-85° F. and a second series placed in an electric refrigerator at a temperature range of 35°-40° F. Monthly counts of the number of new and exhausted perithecia have been made since the beginning of this experiment in March, 1934. The data obtained through February, 1935, show that appreciably more new perithecia were formed under moist than under dry conditions. Also more perithecia became exhausted under moist than under dry conditions. This was true for both temperature ranges tested, although somewhat greater fruiting activity took place at the higher temperature range.

(C) In another experiment disks of infected bark were used to test the effect of abruptly alternating moisture and dryness. On disks kept under alternating (1 day) moist and dry conditions, mature perithecia vigorously extruded their spores and in the course of a week became exhausted. Apparently exhaustion of perithecia was more rapid under alternating conditions than under constant moist conditions.

Perithecia subjected to moist conditions for several hours may forcibly expel ascospores to a distance of 1 centimeter from the bark surface. Ehrlich (5) also noted the expulsion of ascospores of the *Nectria* of the beech disease. Continued exposure of these perithecia to moist conditions for one or two days may result in the accumulation of masses of ascospores at the tips of the perithecia. One of these ascospore masses when it becomes dry appears as a white cap on the

top of the red perithecium. They may remain attached to the perithecia for some time after they are dry, or they may break off. These ascospores readily germinate in drops of water on glass slides in 3 to 4 hours, and microconidia may be formed on the resultant mycelium in 3 days.

Perithecia on bark disks held under dry conditions for one year and then subjected to moisture react slowly. However, some of the perithecia still contain ascospores and apparently some of these are still viable.

The results of these experiments corroborate one another in showing that moisture is a controlling factor in the fruiting activities of *Nectria*.

NECTRIA CANKERS AND FRUITING AS RELATED TO HOSTS

The hardwood tree species vary in their susceptibility to the *Nectrias* as shown by the frequency of cankers. No species is cankered in all stands, although red maple comes close to it. Nor can any of the hardwoods be considered as immune. In outbreak areas sometimes but two or three species are cankered; and there are all gradations up to those where practically every species shows some cankers. With our present information we can do no more for the New England hardwoods than tentatively to rank the tree species as to susceptibility. Some trees are very generally distributed throughout our forests, while others are rather limited and local in occurrence. This makes it difficult to estimate their relative susceptibility to *Nectria*. We can say that some are generally distributed (within their range) and are commonly cankered. Such species are: red maple, yellow birch, sweet birch, and to a somewhat lesser extent gray birch, paper birch, sugar maple, mountain maple, red oak, black oak, and largetooth aspen.

On the other hand, the following species are not commonly cankered in New England: white ash, white oak, American elm, hickory, basswood, and scarlet oak.

Welch (18, 19) has given a list of those hardwood species which he has seen with cankers in New England and New York. There is no doubt that such lists can be enlarged with further search.

There is also great variation in the number and locations of the fruiting bodies of *Nectria* on cankers. Observations taken on more than 1,000 cankers during the past year show that *Nectria* fruited abundantly on many cankers of girdled and felled black oak, sweet birch, yellow birch, and some on largetooth aspen. In contrast to these, the cankers on aspen and gray birch bore only a few fruiting bodies.

In general the fruiting bodies observed were located within or close to the cankered area and often were found on the bark surface of the callus ridge at the outer edge of the canker. A few exceptions to this were noticed in the case of cankers on black oak, where fruiting occurred on the roughened bark a foot from the apparent center of the bare covered canker. In the case of girdled sweet birch and beech, fruiting bodies were found occasionally on the fresh cut surface of the wood at the girdle. They also appeared on the cut surface of sweet birch, paper birch, and black oak stumps.

The present canker studies indicate that in general *Nectria* fruiting is confined to a limited portion of the canker, and its abundance varies directly with moisture. It is worthy of note that the common hardwood canker-forming *Nectria* have been found to fruit on rather limited areas, as contrasted with the abundant diffuse fruiting of *Nectria cinnabarina*, which is usually saprophytic on beech and maple.

PARASITISM OF NECTRIA ON DIFFERENT
HARDWOODS

One of the most urgent questions in the Nectria problem is whether Nectria from one tree species will infect other species of hardwoods. The most reliable way to answer this is by means of cross inoculations with pure cultures taken from various host trees. A number of such tests have been made in Europe (12, 13, 15, 21) as well as in North America (1, 2, 4, 5, 9, 19), but they fail to satisfy fully the present need for this region and its hardwoods. Two series of cross inoculations have been made by us. The first was started in November, 1933. These were made in saplings ranging in diameter from one-half inch to three inches, with the majority of the smaller sizes. When the fungus infected them it quickly killed many, and the fungus in many cases then failed to fruit, probably because of drying out of the dead bark.

Another larger series of inoculations was made at Cherry Mountain, New Hampshire, in April, 1934, on larger trees. Twenty-six cultures originating from single ascospores from perithecia taken from different tree species were made. These originated as follows: beech (13 cultures); sugar maple (3 cultures); yellow birch (2 cultures); black oak (1 culture); largetooth aspen (2 cultures); sweet birch (1 culture); apple (1 culture); red maple (1 culture); American elm (1 culture); bitternut hickory (1 culture). Each culture was used in making inoculations on the following hardwoods: apple, beech, aspen, white ash, paper and yellow birch, mountain, red, striped, and sugar maple, pin cherry. Four inoculations were made on each tree at 4½ feet above the ground, on the north, south, east, and west sides. Pole sized trees were used wherever possible. Owing to the limited number of the following species in the area, only

one tree of each was inoculated with each culture: apple, white ash, mountain and striped maple, and pin cherry. Two trees of each of the other species were inoculated. Four checks were made 1 to 1.5 feet above the inoculations on alternate trees, making half as many checks as inoculations. Detailed notes have been taken twice, and collections of fruits formed on the cankers resulting from the successful inoculations were made every two weeks from July, 1934, when the first were formed, to November, 1934. Some inoculations have not shown definite canker formation although it is quite certain that infection has taken place. These are being left undisturbed to allow development in 1935, after which they will be dissected. For this reason the results are incomplete, and it has seemed best to present only the known positive results here.

These results are based, first, on definite canker formation as judged from external appearance without dissection; and, second, on the presence of perithecial fruits formed on many of the inoculation cankers, and comparison of cultures from them with the culture originally used in making the inoculations. The checks, nearly 1,000 in number, judged on the same basis as the inoculations, showed contamination in less than 1 per cent. Considering that the test was made in the open, natural forest, this is believed to be quite satisfactory. This low amount of contamination in the checks indicates a probable similar small amount of contamination in the inoculations.

Figure 1 shows between what hosts successful cross inoculations have been made. It is evident, when one considers the commonly occurring forms of Nectria as a group, that this group is not limited to any one host but can be transferred readily between a number of different host species. It is possible that further detailed study will result in the recogni-

tion of specific forms of *Nectria* which may have limited host ranges. But the results obtained to the present time indicate that in New England the practical forester generally will be dealing with a single *Nectria* with wide host range rather than with several species of *Nectria* with narrow host limitations. On this basis then, for the present, the forester should consider *Nectria* cankered northern hardwoods, regardless of the tree species, as a possible source of infection for the other hardwoods present in the stand.

It is shown by the inoculations that weed species, such as mountain and striped maple, may be infected by *Nectria* taken from some of their more valuable neighbors. Moreover *Nectria* from natural cankers on striped and mountain maple is like that causing cankers on sugar maple, yellow birch, etc., so there is strong evidence that the *Nectria* on these weed trees will readily attack our better hardwoods. The fact that ascospores are thrown off to a distance of 1 centimeter, as determined in the above-mentioned bark disk experiments, indicates plainly that these spores are carried by air currents. This means that sources of infection have a wide possible influence. It is likely that viable spores, capable of producing infection, are present in quantities throughout our hardwood stands. It is, therefore, useless to attempt entirely to eradicate *Nectria*. On the other hand, it is feasible to reduce the number of such spores by reducing the number of spore-producing cankers in any stand improvement work that is carried on. The larger the area that is so treated, the more effective will be the reduction of infection, as abundant spores from outside the area must travel farther and are more likely to lose viability before reaching places on the trees favorable for them to produce infection. It is known that with most plant diseases, infection is common enough to be impor-

tant only when great numbers of spores are present. Although every fungus spore theoretically can cause an infection, a large proportion of fungus spores never reach situations favorable for them to do so. Consequently, the resultant infections decrease very rapidly as the total number of spores decreases. This makes it important to decrease the number of fruiting *Nectria* cankers even where it is impossible to attempt the destruction of all such cankers.

THE BEECH CRYPTOCOCCUS-NECTRIA DISEASE

For several years it has been known that there was a disease which was killing beech extensively in Nova Scotia, New Brunswick, and more recently in Maine. This was first reported by Faull (6) and Swaine (17) and was investigated by Ehrlich (4, 5) under the auspices of Harvard University and Canadian national and provincial governments. The disease was reported as due to the attacks of an insect followed by a species of *Nectria*.

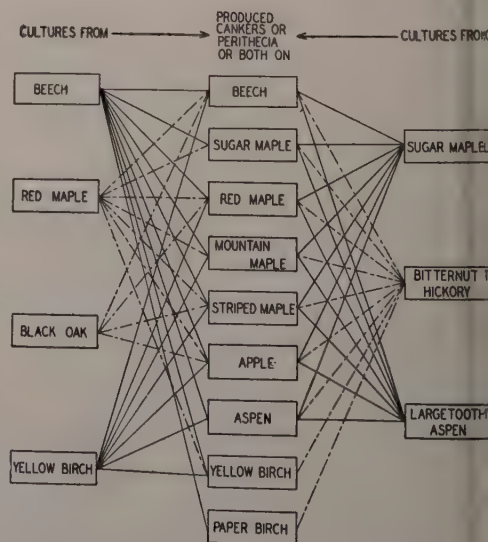


Fig. 1.—Diagram showing successful cross inoculations made with *Nectria* on New England hardwoods.

which attacked the bark injured by the feeding of the insects.

The insect has been known in Europe for many years and has caused recurrent harms there because of outbreaks on the European beech. A number of fungi, including *Nectria ditissima*, have been reported as associated with the dying of beech in Europe (5, 12).

In North America the insect apparently first appeared at Halifax (5), Nova Scotia, before 1914, and has established itself extensively in eastern and southern Maine and in scattered areas as far west as Westchester County, New York. *Nectria* is commonly associated with the insect injury in the Canadian provinces as far west as the vicinity of Augusta, Maine. The *Nectria* associated with this disease appears to be a follower of the insect, the latter weakening the bark in patches where dense colonies feed. The insect apparently creates conditions favorable for the fungus, which attacks so aggressively as to girdle and kill trees severely injured by the insect (5, 17). Entomologists investigating the dying beech believe that it is by no means improbable that trees severely attacked by the scale insect over a period of years could die in any event, whether the insect injury is followed by the fungus or not. From Ehrlich's report (5) one infers that but one *Nectria* is present on the diseased trees. It appears, where colonies of the insect have fed, in rather thickly scattered groups of reddish fruiting bodies, each the size of a small pinhead. So dense are they sometimes that a heavily attacked tree trunk when seen from a slight distance assumes their reddish color. Since other organizations are studying the problem, it was thought desirable to duplicate those investigations. In order to supplement the work done by other agencies 37 plots were

established in eastern Maine in October, 1933, by representatives of the U. S. Bureau of Entomology and Plant Quarantine (Messrs. Brown and Baker) and the Bureau of Plant Industry (Ayers), working cooperatively. These plots included all stages of disease, from none to heavy with dying trees. Descriptive notes were taken and 50 beech trees tagged in each plot. Brown has published general statements covering his records for 1933 (3).

In June and September, 1934, notes were taken concerning plot description, tree condition, abundance of *Nectria*, and scale present on each tree. Classification of the scale abundance was made in cooperation with an entomologist.

One plot was abandoned and a few trees have been lost in other plots because of cutting by the land owners. This report is, therefore, concerned only with the records taken on 1,785 trees located in 36 plots of 50 trees each originally. *Nectria perithecia* have been found on 209 trees, or 12 per cent of the total number of trees. This percentage does not appear alarming, but consideration of the distribution of these diseased trees is more significant. Six plots had 78 per cent or 163 of the diseased trees, and in 4 of these plots over three-fifths of all of the trees were infected with *Nectria*.

Previous to the establishing of the Maine plots, collections of *Nectria* were made by a number of investigators.⁷ When the present plots were established in Maine, Ayers also made collections of *Nectria perithecia* from a number of beech trees. It became increasingly evident that more than one form of *Nectria* is present on the plot trees in Maine. For the purpose of convenient presentation in this paper, the *Nectria* which was determined as that described by Ehrlich

⁷Early collections were made by R. P. Marshall, M. MacKenzie, K. F. Aldrich. Collections were also made by Haven Metcalf and R. P. Marshall in the summer of 1933.

is referred to as *Nectria* number 1. All other forms of *Nectria* will be referred to in this discussion of the beech *Cryptococcus-Nectria* disease as a group and called *Nectria* number 2.

In September, 1934, 151 collections of *Nectria perithecia* were taken from the bark of 149 tagged trees located in 23 plots. Subsequent culture study of these collections showed that 40 of the collections, determined as *Nectria* number 1, came from trees located in only 8 plots, while 90 of the collections, determined as distinctly different and included in *Nectria* group number 2, were taken from 21 plots. Thus *Nectria* number 2 had a wider distribution than *Nectria* number 1. Thus it was found that there were two distinct *Nectrias* on the insect-infested beeches. Ehrlich's *Nectria* was much more abundant. Whether either *Nectria* is really significant in the killing of the beeches is still uncertain. *Nectria* number 2 as mentioned under this heading includes among others those forms of *Nectria* which are commonly associated with cankers on various hardwoods. Thus we find that canker *Nectrias*, as well as Ehrlich's *Nectria* (our number 1), are apparently attacking the weakened bark of scale-infested trees. It is significant that *Nectria* cankers have been observed on hardwoods (mostly birches and maples) in close proximity to 19 of the plots.

ABUNDANCE OF NECTRIA VS. SCALE INFESTATION

An estimate of the abundance of *Nectria perithecia* was made in the field for each of the 209 plot trees infected. Each tree was placed in one of 6 classes according to the abundance of perithecia. The 6 classes in order may be expressed by the following: None, rare, occasional, common, abundant, very abundant.

The degree of scale infestation, ex-

pressed as none, trace, light, medium, and heavy, was obtained from the records of the pathologists made in the field in co-operation with the entomologists. The trees were grouped according to the maximum degree of scale infestation during the two years under observation, and also according to the abundance of *Nectria perithecia*. A summary of these data is presented in Table 1.

A few trees were found to be lightly infected with *Nectria* numbers 1 and 2, even though no scale has been found on them. In contrast to these few trees it is important to note that the majority of trees lightly infected by *Nectria*, as well as all of those with abundant *Nectria* fruits, have had a medium or heavy degree of scale infestation.

The data in Table 1 show that with the number of beech trees infected and the abundance of *Nectria perithecia* on the infested beech are greater in areas where the degree of scale infestation is medium to heavy. Apparently this is true of *Nectria* number 2 as well as of *Nectria* number 1. But a study of the available data indicates that increase in abundance of *Nectria* number 1 has been most favored by the presence of a medium to heavy degree of scale infestation. However, more than half of all trees with medium to heavy scale infestation are not infected with *Nectria*, which may indicate an appreciable lag of the fungus in following the insect.

It is evident that *Nectria* may cause some damage on beech in non-scale areas. The amount of damage by *Nectria* in scale areas is not only related to such factors as the degree of infestation by the insect, the age of that infestation, the size of the tree or the portion infested and the environment in which the tree is growing, but in addition there are possible variations in damage due to the species of *Nectria* present.

The results obtained from the field

ydy to date strongly indicate that the greatest damage to beech is caused by combination of scale infestation and Nectria infection. However, the data obtained from the Maine plots as well as observations of scale infested trees in Massachusetts and Connecticut show that Nectria infection has not, in all cases, allowed even medium to heavy degrees of scale infestation. The reasons for this are not known, but the data obtained from the studies to date suggest that moisture as well as available sources of inoculum may be important controlling factors. For example, trees with relatively large amounts of scale and no apparent Nectria infection were most frequently found to be located in parks and cemeteries or by open roads. Trees in these locations are perhaps more rapidly dried following a rain than those located in denser forest stands. This quick drying may help to prevent infection. It was further noted that in many cases these apparently Nectria-free, scale-infested beeches were located in areas where few or no Nectria cankers could be found in other hardwoods in the vicinity. In fact the only scale-infested beeches with Nectria infection found in Massachusetts were some beeches located at Hamilton in close proximity to cankered birch. Cultural determinations of the perithecia obtained from these beeches and the birch cankers indicate that the same organism is present on both, and that it is

our so-called Nectria number 2. The above facts, plus the results obtained from the inoculations, indicate that Nectrias present on various cankered hardwoods may be expected to infect beech. The data obtained from the Maine plots indicate that scale infestation may influence the number of beech infected as well as the intensity of Nectria infection. The field studies in the Maine plots have not proceeded far enough yet to determine how much damage may be expected of the various forms of Nectria, or under what condition the greatest damage is caused. However, the results indicate that both the rather specific form (Nectria number 1) and the forms commonly found associated with cankers (Nectria number 2) on various hardwoods must be considered.

Nectria cankers have been found in many of the stands in the Northeastern forest area. Thus, for this area, the distribution of Nectria number 2 is general. On the other hand, Nectria number 1 has been reported as present only in Nova Scotia, New Brunswick, and Maine. In addition N. A. Norton (Emergency Conservation Work) sent to this laboratory collections from North Woodstock, New Hampshire, which Ayers determined as a form of Nectria morphologically similar to Nectria number 1. Grant collected Nectria from a frost crack on sugar maple at Peru, Vermont, which was subsequently determined as similar morphologically to Nectria number 1. Both differ

TABLE 1

NUMBER OF TREES WITH NECTRIA CLASSIFIED ACCORDING TO ABUNDANCE OF NECTRIA PERITHECIA AND DEGREE OF SCALE INFESTATION IN 1933 AND 1934

Maximum scale infestation 1933-1934	None	Number of trees classified by abundance of Nectria 1 and 2					Total trees with Nectria	Total trees
		Rare	Occasional	Common	Abundant	Very abundant		
None	712	9	1	0	0	0	10	722
Trace	216	12	1	0	0	0	13	229
Light	320	20	2	1	1	0	24	344
Medium	186	33	12	3	6	6	60	246
Heavy	142	40	22	23	11	6	102	244
Total	1576	114	38	27	18	12	209	1785

somewhat in culture from each other and from *Nectria* number 1. These collections were taken in areas where, as far as is known, no scale has ever been found. Thus it appears that rather slight variants of *Nectria* number 1 occur widely separated from the beech insect, and apparently entirely independent of it.

PRACTICAL CONCLUSIONS

On the basis of definite trends in some of the unfinished work and the results of that now ended, it can be said for New England that:

In silvicultural work *Nectria*-cankered trees should be used for cord wood and the slash burned whenever that is economically feasible. *Nectria*-cankered trees which must be left in the woods should be girdled or felled as may be most practicable under the local conditions. However, it is inadvisable to attempt to eradicate completely *Nectria* cankers in many stands because of excessive cost and the certainty that some branch cankers will be left with the best work possible.

For reasons given in the preceding, in all forest improvement work the reduction of *Nectria* spore production by removal of *Nectria* cankered trees, where strong silvicultural reasons do not require their retention, should be a regular and important feature.

Cankers occur even in sapling stands and should receive especial attention in their treatment. In this way a future pole stand with a minimum of cankering may be obtained. The consistent discrimination against *Nectria* cankered trees throughout the life of a stand up to large pole size should effectively control this disease. Here rests one of the greatest opportunities open to real forest improvement in hardwoods.

While moisture is a strong factor controlling *Nectria* fruiting, the work is too

incomplete to evaluate properly its practical importance.

Experience shows that red maple, sweet birch, and yellow birch are most often cankered, while white ash, white oak, American elm, and scarlet oak are not commonly cankered by *Nectria* in New England.

Cross inoculations show that canker-forming *Nectria* will freely go from one hardwood species to most others. The forester should consider the canker *Nectria* as a closely related group which must be discriminated against in his improvement work.

The fact that weed species, such as mountain and striped maple, harbor canker-forming *Nectria*, is an additional reason for removing them from hardwood stands wherever practicable.

The beech *Cryptococcus-Nectria* disease of south-central and eastern Maine is caused by a complex of injury by the insect and attacks by *Nectria* in the injured bark. Severely attacked trees are killed. It is still uncertain how much relative damage each of the agents causes. Diseased trees have been found to be infected by other *Nectrias* than the one which is most commonly associated with the insect.

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BRIEFER ARTICLES AND NOTES

NOVEL TOOL FOR TRANSPLANTING WILDINGS

In October, 1931, transplanting wild stock with a cylindrical spade was tried on the Cut Foot Sioux District of the Chippewa National Forest. White and Norway pine seedlings, 12 to 14 inches in height, were transplanted. The transplanting was done in a Norway pine and white pine seed tree type. One portion of the type had seeded in very well, due to the strategic locations of white pine seed trees, while the other portion of the type had seeded in very lightly, due to the absence of white pine, with a few Norway pine and a few white spruce mixed in.

The cylindrical spade was made at a cost of \$3.75, by a local blacksmith by taking an ordinary garden spade and welding two halves of a round pointed shovel onto either side. The spade thus made was approximately 8 inches in diameter and 11 inches in height. Figure 1 gives an accurate idea of how the spade looks and how it is made.

On the particular job mentioned above, the seedlings were transported on a stretcher carried by two men from the place where they were dug to the place where they were planted—an average distance of 500 feet. The area planted up was quite open, being free from brush and slash.

The total cost of planting per thousand trees was \$8.27. Adjacent plantations of 3-0 stock were planted during the same planting period with a planting bar, using the same spacing (6 x 6 feet) but nursery grown stock, at a cost of \$13.58 per thousand trees.

The survival at the end of the first

and second years was 95 per cent and per cent respectively; however, the second year (1933) was a severe drought year with growing conditions at the worst.

The procedure in digging and planting this wild stock is as follows:

The cylindrical spade is slipped over the top of the tree and shoved into the ground by stepping on it with the foot. About two shoves are necessary to shove it into the ground clear to the hilt. The hilt in this case is made up of flat guano approximately 1 inch in width, welded onto the top of the blade. This is necessary to prevent the blade from cutting the operator's shoes when driving it into the ground. The shovel is then pulled out and turned completely around to the other side of the tree and the process repeated. The spade with the tree and ball of earth in it is then lifted out of the ground and the tree with its ball of earth can be placed on the stretcher, stock boat, wagon, truck, or whatever means of transportation is being used. The ball of earth will slide out of the spade by a slight jerk being made on the spade handle.

The hole to plant the trees in is made the same way as described above. However, it should be made a trifle deeper than the digging hole is. After the tree is taken out, the ball of earth with the tree in it is then placed in the planting hole and tamped down with the heel of the foot the way round.

RESULTS

The results to date indicate that the planting of wild stock can be carried out very cheaply compared to other plan-

The cost of planting could probably be cut down considerably from \$8.92, inasmuch as we had to charge the whole cost of the spade against the 5 acres planted and inasmuch as there was considerable contributed time charged against planting also.

It is believed that the wild stock could be transported several miles between the

digging and planting area without undue cost. On short distances a stretcher is recommended; on distances of $\frac{1}{8}$ to $\frac{1}{4}$ mile a one-horse stone boat could probably be used; and on long hauls of 2 or 3 miles a long platform truck would probably be best. This tool offers possibilities for transplanting "wildings" on ranger station grounds, recreation areas, etc.

The survival compares very favorably with the survival on other areas planted. It is recommended, however, that this size cylindrical spade be used only on wild stock up to 12 inches in height. When used on trees over this height, too many of the roots are cut off. In the planting that has been carried on to date, it is believed that a small percentage of the trees planted were too large. It might be mentioned that the survival to date is very good considering the fact that the trees have gone through two of the driest seasons ever experienced on this forest, and inasmuch as the planted area is very much exposed to the direct rays of the sun.

Further conclusions will be drawn after the first five-year count on survival has been made.

GERALD S. HORTON,
Shawnee Purchase Units.



A RULE OF THUMB FOR LOG SCALING

Practically every forester has had use, at one time or another, for a simple, accurate method of determining the board foot content of a log or a tree. The Doyle rule has usually recommended itself in emergencies because of its simplicity, especially when applied to sixteen-foot logs. However, the gross inaccuracy of this rule is such that even a person with very little experience can often estimate the volume of a log with



Fig. 1.—Tool for transplanting wildings.

greater accuracy than can be obtained by applying the rule.

After considering some thirty rules, the Clement log rule was found to give values that very closely approach those of the International $\frac{1}{4}$ inch kerf. The Clement rule as stated in Chapman's Forest Men-

suration is $BM = (.7854D^2 - 1.57D) \frac{L}{16}$.

D=diameter in inches inside bark at small end of log.

L=length of log in feet.

Simplifying this and bringing it into a form applicable for use on 16-foot logs, the equation becomes:

$$BM = .7854 (D^2 - 2D)$$

Rounding off the coefficient to the nearest tenth and rearranging the terms for more simple calculation, the formula obtained is:

$$BM = .8D (D - 2)$$

The average deviation from the International rule, $\frac{1}{4}$ inch kerf, for diameter values ranging from 6 to 30 inches is 1.2 per cent for the above rule and 23.1 per cent for the Doyle rule. The same converting factors used with the International rule to modify its values for different saw kerfs may be applied to this formula because of the very close relationship which exists between the two rules. As an example, the scale of a 20-inch log, 16 feet long, $\frac{1}{4}$ inch kerf, is $(20)(18)(.8) = 288$ feet B M. For $\frac{1}{8}$ inch kerf this value should be increased by 10 per cent, giving a volume of 317 feet B M. The corresponding values for the International rule are 290 feet B M and 320 feet B M respectively.

In the form $D(D-2)(.8)$ the necessary computations are simplified to such an extent that the mathematically minded forester may perform the work mentally. By use of this formula, a reliable value can be obtained for the board foot con-

tent of a 16-foot log. For lengths other than 16 feet the formula should be divided by 16 and multiplied by the desired length.

JOHN C. SAMMI,

New York State College of Forestry.



THE ST. LOUIS MEETING OF THE A.A.A.S.S.

The St. Louis meeting of the American Association for the Advancement of Science, held Dec. 30, 1935-Jan. 4, 1936, like the ones at Boston and Pittsburgh previously reported in these pages by the writer, included in its program much of forestry interest. No sessions of the Society of American Foresters were held independently or jointly, but when thumbing through the 200-page program one observed about 46 papers of direct forestry interest, not counting many applying to range ecology, soil science, wild life and other subjects allied with forestry. Unfortunately, owing to the extremely dilute arrangement of St. Louis (9 mi. X 19 mi.) attempts at attending more than one session at the same time were unusually futile. There were, however, several symposia of forestry import; one on land utilization under the auspices of the Association of American Geographers, and one on "Ecological aspects of some recent governmental activities," by the Ecological Society of America. There was also a session of this society devoted to papers on forest ecology, and one of the Society of Economic Entomologists dealing with insects affecting forest and shade trees.

Papers with forestry implications might be found also on the programs of the other societies in the groups of biological sciences, economics, and agriculture. Several papers were presented by members of the Forest Service. The exhibits of

¹Report of the Permanent Representative of the Society of the Council of the American Association for the Advancement of Science.

books, apparatus, etc., were especially extensive and well-quartered in the new Municipal Auditorium. Among them were booths of the Forest Service and Soil Conservation Service, as well as a very complete display of air photographs and aerophotogrammetry by the U. S. Engineers' office. Instructional talkie films on a wide range of scientific subjects were shown by the Erpi Picture Consultants, including an especially good series on geology. They are free from any suspicion of the preponderance of which "educational films" are occasionally accused. It is to be hoped forestry may soon be included in this series.

Comparatively few foresters could be found absorbing these opportunities. Among those identified however, were said to be P. D. Kelleter, Robert Marshall, H. L. Shirley, L. J. Pessin, V. A. Young, A. G. Chapman, J. M. Aikman, H. von Schrenk, E. Wright, H. Hopp, C. M. Deam, S. A. Graham, and A. A. Granovsky.

As a member of the Committee of Section O (Agriculture), representing the society on the A.A.A.S. Council, the writer attended council meetings on all our days on which they were held, and devoted the greater part of his time outside to furthering action by the Council and by affiliated societies on projects in which foresters are concerned. In the absence of instructions from the Society, his activities centered around the passage of a resolution endorsing Dutch elm disease control, first by the American Phytopathological Society and subsequently by the Executive Committee of the A.A.A.S. with power to act; and the adoption of a resolution by the Ecological Society favoring the creation of a central seed laboratory for tree seed testing and control.

Meanwhile, H. L. Shirley secured passage of similar resolutions by the Botanical Society and American Society of Plant Physiologists.

The writer conceives the duties of the Society representative to be, first, to interest and keep foresters in touch with progress in other fields of science, and secondly, to acquaint scientists with what foresters are doing and thinking about. In the present instance the second aspect was developed as occasions permitted, and membership on the Council was not permitted to be one entirely of passive acquiescence; in this your liaison officer succeeded at least to the extent of converting a reputedly "stuffed shirt job" into a wilted shirt job.

The chief business of the Council was passage of resolutions favoring calendar reform (a 12-month, equal quarter plan preferred), reform of patent laws, and the setting aside of natural areas. Local sections of the A.A.A.S. are growing in popularity and foresters in certain isolated sections, if such there be remaining in these days, might well take the initiative in organizing them. It might be pointed out here that members of the Society may join the A.A.A.S. without payment of the usual initiation fee because of the affiliation of the Society. There are now some 153 affiliated societies, with the total aggregate membership (including some duplication of course) numbering around 750,000. Consequently, endorsement by the A.A.A.S. Council should carry considerable weight. The summer meeting of the American Association will be held at Rochester, N. Y., and next year's winter meeting at Washington, D. C., when, it is hoped, the Society of American Foresters will meet in conjunction with it.

HENRY I. BALDWIN.



REVIEWS



The Design of Experiments. By R. A. Fisher. *Oliver and Boyd, Edinburgh.* 252 pp. 12/6 net.

Through his work in statistical theory, the logic of inference, and particularly through his excellent book "Statistical Methods for Research Workers," Professor Fisher is too well known in the broad fields of biology and agriculture to need introduction.

He has now produced a companion volume to "Statistical Methods for Research Workers" in his latest book "The Design of Experiments." In the former he has illustrated the application of exact tests—based largely on his own researches in mathematical statistics—to the practical data of laboratory and field experiments so that valid conclusions may be drawn. To him, however, this is not enough; for we read in the preface of the new book: "A clear grasp of simple and standardized statistical procedures will, as the reader may satisfy himself, go far to elucidate the principles of experimentation; but these procedures are themselves only the means to a more important end. Their part is to satisfy the requirements of sound and intelligible experimental design, and to supply the machinery of unambiguous interpretation."

The introductory chapter contains a discussion, among other preparatory topics, of the grounds on which evidence is disputed. In the second chapter certain principles of design are illustrated by means of a simple experiment to test the veracity of a lady's assertion that she can tell, by tasting a cup of tea, whether milk or tea was first poured into the cup.

The third chapter consists of a re-

examination of one of Charles Darwin's experiments to determine whether the difference in origin of inbred or cross-bred maize plants influences their growth rate. While showing that modern tests substantiate Darwin's conclusion, the author draws attention to the necessity of a valid estimate of experimental error in words that the experimental forester might well take to heart: "It is possible, and indeed it is, all too frequent, for an experiment to be so conducted that no valid estimate of error is available. In such a case the experiment cannot be said, strictly, to prove anything. Perhaps it should not, in this case, be called an *experiment* at all, but be added merely to the body of *experience* on which, for lack of anything better, we may have to base our opinions. All that we need to emphasize immediately is that, if an experiment does allow us to calculate a valid estimate of error, its structure must completely determine the statistical procedure by which this estimate is to be calculated. If this were not so, no interpretation of the data could ever be unambiguous; for we could never be sure that some other equally valid method of interpretation would not lead to a different result."

The fourth and fifth chapters deal with the randomized block and the latin square designs, respectively. The simpler patterns of these general designs have been in use since Fisher's earlier work. But complex extensions of them which have not been understood very well are treated in the next four chapters. The tenth chapter, on the generalization of null hypotheses, and the eleventh and final chapter on the measurement of amount of information, have to do with analyses of properly de-

signed experiments rather than with design itself.

Only the first three or four chapters may, perhaps, be called light reading, although the whole is written in that elegant style which characterizes all of Fisher's writings. Except for the last chapter the treatment is essentially non-mathematical. The experimental forester will find it stimulating and suggestive throughout.

F. X. SCHUMACHER,
U. S. Forest Service.



Improvement Cutting and Thinning as applied to Central New England Hardwoods. By A. C. Cline. Prepared at Harvard Forest, Peter-sham, Mass. Published by the Mass. Forest and Park Association, Boston. 16 pp. Price 50c.

This bulletin has been prepared for distribution by the Massachusetts Forest and Park Association in furtherance of its educational program directed toward the improvement and restoration of New England's woodlands.

That a great part of the hardwood area in central New England is in need of improvement cuttings and thinnings is not to be doubted, nor the fact that it can be raised from its present haphazard condition to a thrifty and productive status by intelligent treatment. This bulletin by Cline points the way with vigor and clarity to this systematic forest practice, the application of which is so necessary to the raising of hardwood crops of better quality.

This bulletin is in effect a handbook or manual. A brief introduction explains the origin and condition of the present forest stands. Under main headings, Improvement Cuttings and Thinnings are discussed in detail, with the *why* and *how* of the numerous silvicultural problems clear-

ly described. Under another heading Cline gives an excellent statement of expectable returns from improvement cuttings and thinnings. Included, also, is a very practical statement on the relation of silvicultural treatment to the control of the Gypsy moth. Definitions of terms are given and the bulletin carries four excellent illustrative half tones and also two working diagrams of forest stands that are in need of treatment.

This clearly written and well arranged bulletin will be of great value to the many woodland owners who, desiring to care for their forest properties, seek specific directions on what to do and how to do it.

R. P. HOLDSWORTH,
Massachusetts State College.



Low Versus High Thinning. By Fredrik Bång. *Skogen* 22:193-197. May 1, 1935.

The term high thinning as used by the author is more nearly akin to our term selection thinning. In fact he states: "High thinning is thus similar to selection thinning and to single tree selection." This matter of terminology is stated at the outset to clear up whatever misconceptions the reader may get from the title.


The paper is a discourse on the advantages of selection thinnings and selection cuttings in those forests which are pure Norway spruce or contain an appreciable amount of spruce in the mixture. The author presents arguments which are more or less familiar to American foresters, among others maintenance of site quality and ease of obtaining natural reproduction. The main thesis, however, is concerned with the relationship between silviculture and wood quality, a field which has received comparatively little attention in this country as yet, aside from the contributions of Benson H. Paul.

The author maintains that rapid early growth is not desirable and that it should be held in check by proper silvicultural procedure. He discusses the production both of pulpwood and of larger timber. Close-ringed wood is more desirable as pulpwood than wide-ringed, for many reasons, among which are higher cellulose content per unit of volume, lower manufacturing costs, and higher quality final product. Those stems which are to be ultimately utilized for large timber should be grown slowly at first and then the growth rate slowly but constantly acceler-


ated until the tree is harvested. In this manner clear timber of more desirable mechanical qualities and less subject to decay is produced.

The paper presents the viewpoint of the author, documented to some extent by the studies of others, but represents no original investigations. It excites curiosity in a field of forestry which must be developed if wood is successfully to meet competition from substitutes.

J. L. DEEN,
Pennsylvania State College.



CORRESPONDENCE



COMMENTS ON THE ICKES-CHAPMAN CORRESPONDENCE

LAST summer the JOURNAL OF FORESTRY gave much space to the fortunes of the so-called Lewis Bill. In the four issues from June to October nearly one-eighth of the reading matter concerned this proposal to make the Interior Department the Department of Conservation—a proposal which, it should be remembered, is still pending legislatively.

One reason for giving the subject so much attention was the fact that the President of the Society, acting on its behalf, was vigorously opposing the bill. Manifestly, the Society should have full information on what is done in its name, so that, if opinion is divided, the fact may be brought into the open. The JOURNAL should be an instrument for the expression and formation of Society sentiment.

Neither the President of the Society nor the Editor-in-Chief of the JOURNAL wish to use space in the JOURNAL merely to record praise. When, however, divergent views appear, the Society is entitled to hear from both sides.

The immediately following communication shows that at least one member of the Society feels a sufficiently deep interest to speak out his mind, for publication, in dissent from the course taken by the JOURNAL and the President. The subsequent communications on the same subject bear much earlier dates, and are now made available for publication by President Chapman, on request, to round out the picture. Letters of like tenor were sent Chapman in considerable number.—*Editor-in-Chief.*

December 26, 1935.

Editor, JOURNAL OF FORESTRY.

DEAR SIR:

I think I have read every word of the controversy over the Lewis Bill, S-2665, which would change the name of the Department of the Interior and present a possibility that the Forest Service might be transferred from the Department of Agriculture to the Department of Interior.

I imagine that this subject will be discussed further both in the pages of the JOURNAL and in news releases as well as at the Atlanta meeting of the Society.

May I ask, as a member of the Society of American Foresters, that some attempt be made to put this controversy on a more dignified plane and that future material

published in the JOURNAL, at least, refrain from personalities.

Personally, I have a feeling of having been spoken for a little too much and too bitterly.

Very truly yours,

SHIRLEY W. ALLEN.

July 15, 1935.

DEAR MR. CHAPMAN:

I just want to say that I most thoroughly enjoyed reading the interchange of letters between Secretary Ickes and yourself. You do not suffer in the slightest in the comparison of these epistles. On the contrary, you score very heavily.

I am mighty glad that you are President of the Society under these circum-

stances; and that you have not only the courage to speak right out in meeting, but the poise and wisdom to make your shots hit with telling effect.

Sincerely yours,

W. B. GREELEY.

August 5, 1935.

DEAR CHAPMAN:

I want to express my admiration for you in dealing with Secretary Ickes and the bill dealing with the proposed Department of Conservation and Public Works, and also to express my entire approval of the action taken. I felt that you were not given a fair chance to bring out the points you wanted to emphasize at the time of the hearing before the Senate Committee on Public Lands, which I at-

tended, but you have certainly come back good and strong in the press releases.

At the possible risk of splitting your hat band I am prompted to remark how fortunate the Society of American Foresters is in having a President and spokesman who can speak fearlessly and effectively on these public questions, instead of having a man in that position so hog-tied by federal domination as to be unable to speak for us. When I read what Ickes had to say about you to the effect that you were reading a speech prepared by someone in the Department of Agriculture, it was very evident that he did not know Chapman and was likely to get better acquainted with him very shortly.

Very truly yours,

F. W. BESLEY.

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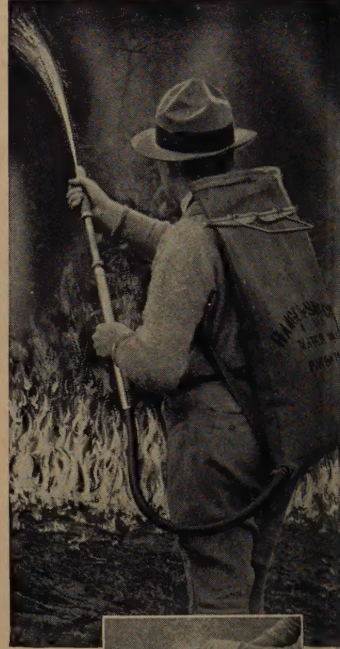
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